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AND

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THE BRITISH FOUNDRYMEN'S ASSOCIATION.

Melting Ratios and Casting Temperatures.

LOOKING over some recent figures by Dr. Moldenke in the February number of the FOUNDRY on the working of cupolas, it is of interest to note some data on iron melting in cupolas given by him. A statement by so well-known an authority will do much to settle the much-debated question of melting ratios. He is of opinion that 1 to 8 may be looked upon as a good average working result for ordinary foundries.

I think this statement will be borne out by those founders who keep a correct daily record of the weight of all materials charged into the cupola—but not those who occasionally make a trial under favourable conditions. Of course, in foundries engaged on special work with continuous runs, better results are obtainable, but in foundries making engine and machine-tool work, where there is a considerable amount of bright or machined surfaces, the above figures, in my opinion, represent good practice, as for this class of work the iron must be properly melted. It does not follow that a saving in coke is always economical, for if the iron is not hot enough for the class of work in hand there may be more than the usual amount of waste, due to imperfect melting.

Most founders engaged in the classes of work mentioned are agreed that hot melting of iron gives the best results; occasionally one gets a melting ratio as high as 1 to 10, but in foundries requiring clean, hot iron the average melting ratios will work out about 1 to 8.

Some iron will melt with less coke than others; this was recently pointed out by Mr. R. Buchanan, but this class of iron is not in great request by foundries for producing strong, high-class castings, on account of the high phosphorus content.

The good effects of hot melting are undisputed, but there is a considerable difference of opinion on the correct casting

temperature for important pieces that must be free from draws and machine clean and solid.

It is the practice in some foundries to pour as hot as possible for all castings that have machined surfaces, while others prefer to allow the iron to work off some of its gases in the ladle before casting. In my experience it is a question of iron. With some mixtures the best results are obtained by pouring very hot; other irons, if cast at the same high temperature, would not give good results; especially is this so with hard, close irons.

With castings having unusually thick flanges joined to comparatively thin walls, and with flanges at each end—these being at the top and bottom of the mould—it is sometimes found, on taking out the casting, that there are one or two small pinholes located near the fillet of the top flange; these defects only show when the iron has been poured very hot, and do not occur if the iron is allowed to stand for a short time in the ladle.

Various opinions are held on strengths of cast-iron poured at high and low temperatures. Keep's experiments show that irons cast at low temperatures are the strongest; while Mr. Buchanan deduces the opposite opinion from his observations, and gives reasons for so doing in the March number of the FOUNDRY TRADE JOURNAL.

The table given below shows the strength of pairs of bars cast from one runner, and it will be seen that the average result of each pair favours Mr. Buchanan's view on casting temperatures for iron.

Experiments made at various times have not enabled me to form a definite opinion on this question. More experiments are required on this point before either view can be accepted as true for all irons.

What is more important, is to know the best casting temperature for pouring in order to insure freedom from defects in the casting.

Test Mark.		B.W. in lbs.	Average B.W. in lbs.
1	Poured hot	2,770	
1	" "	2,720	... 2,745
2	" 1 min. later	2,760	
2	" " "	2,650	... 2,705
3	" 1½ " "	2,830	
3	" " " "	2,460	... 2,645
4	" 2¼ " "	2,580	
2	" " " "	2,480	... 2,530

Recording pyrometers, as now made for the measuring of high temperatures, are costly and wanting in handiness for iron foundry use; at present their use is restricted to brass foundry work, two or three immersions in molten iron sufficing to destroy the poker.

The "Morse" apparatus, used for the hardening of drills, would appear to be the ideal thing for measuring the temperatures of molten iron. With this device a special glow lamp is used, the temperature of the carbon filament being known by the amount of current passing through the lamp.

A set of tables of the current and corresponding temperatures is provided with the apparatus. When in use, the lamp can be adjusted to the desired temperature, and then compared with the molten iron. It is readily seen when the temperature of the lamp coincides with the heat of the molten iron.

This apparatus may be already in use for this purpose; so far, the writer has only heard of it being used for the hardening of drills.

It should be helpful to the ironfounder to know the casting temperature that gives him the best result with a particular mixture of iron, when casting important large pieces. I more particularly refer to large heavy castings. Mr. P. Longmuir has shown the advantages of knowing the best pouring temperatures for the metals employed by the brass and bronze founder. Looking on cast-iron as an alloy, it is possible that the same treatment of iron may have good results.

The uncertainty that at one time attended the making of steel castings has to a very great extent disappeared.

There was a period when only the plainest pieces were made. The castings were very tough, and also very full of holes when the surface was removed, and to prevent this defect showing up too badly it was usual to allow a mere scrape for machining purposes, one-sixteenth of an inch being allowed on horn blocks and similar pieces.

Later, steel castings were made solid and free from blow-holes, but had the defect of being very brittle; in fact, not much stronger than cast-iron. Now castings are turned out free from both these defects.

It cannot be said that the reliable production of sound iron castings has kept pace with the improvements made in steel castings.

C. M. (Rugby).

NOTICE TO MEMBERS OF THE BRITISH FOUNDRYMEN'S ASSOCIATION.—It is requested that those members who have not sent in their postcard *re* the place of the next annual convention of the British Foundrymen's Association, will do so at their earliest convenience, so that the necessary arrangements can be made.

F. W. FINCH,

Hon. Secretary.

THE EFFECT OF METALLOIDS, ETC., IN CAST IRONS.*

William J. Keep, in his work on cast iron, which is a record of original research containing such valuable matter, appears to form the following conclusions with regard to the effect of elements upon cast iron.

Silicon hardens cast iron, but its effect of throwing the carbon out of combination is to soften the metal. The more completely this change is effected the softer will be the iron, provided the silicon does not exceed 3 per cent. It increases the strength up to 3 per cent. in ½ inch bars. The lower the silicon in thin castings the weaker the metal, whilst the reverse is the case in large castings.

Silicon removes the chilling tendency in iron. It increases the fluidity. It reduces shrinkage by changing the combined carbon into graphite.

The shrinkage decreases as the size of the casting increases.

He says: "The founder must be made to realise that it is not the percentage of what is in his iron which is of use to him, but it is the influence exerted by that which is in the cast iron that affects the physical quality."

Phosphorus, if anything, hardens cast iron, reduces the shrinkage, and has no influence on the chill. In any proportion it weakens iron, but has the valuable property of making the iron more easily melted. It has no influence upon the grain of the iron, and does not have any influence on the carbon condition. He says that 1 per cent. is a reasonable quantity for general foundry work, but that American irons rarely contain so much.

Sulphur tends to harden iron. Grey pig rarely contains more than 0.10 per cent. sulphur.

His experiments show that 0.05 per cent. will not exert any appreciable influence, and what little is done is at once corrected if the silicon is slightly increased. He thinks he has shown that the average foundryman's ideas about sulphur are partly superstitious.

Manganese does not materially influence the chill, and what is usually found in foundry irons has no influence on the strength. One per cent. does, however, increase the hardness, independently of the carbon condition. He does not appear to consider that there is any advantage in the use of manganese.

Professor Turner, in his published lectures on iron founding, when discussing the important *rôle* played by combined carbon, says that for maximum tensile and transverse strength this should be 0.47 per cent., whilst for the highest crushing strength it should be over 1 per cent. In referring to the effect of sulphur, briefly stated, he says that its effect is to counteract that of silicon, and that one part of sulphur will counteract the effect of 10 parts of silicon. He suggests that for soft castings the sulphur should not exceed 0.03 per cent. or 0.04 per cent., and in strong metal 0.07 per cent.

He suggests 0.5 per cent. of phosphorus as the amount suitable for strong castings of good quality, but for ordinary practice, where soundness and fluidity are of more importance than strength, from 1 to 1.5 per cent. may be present.

With regard to manganese, Professor Turner says that ferro-manganese may be used for special purposes as a softener, particularly with sulphurous irons.

Professor Howe and Mr. Sauveur very correctly regard pure cast iron as a metallic matrix cut up mechanically by plates of graphite. In very soft iron the matrix is ferrite. In steels of maximum strength the matrix may be regarded as pearlite with about 1 per cent. carbon cut up by graphite plates.

Graphite weakens iron; therefore, if the carbon is partly combined—under 1 per cent.—there will be about 1 per cent. less as graphite, and the cast iron should on that account be stronger than one containing all the carbon as graphite.

Provided the matrix contains no massive cementite, and is all pearlite, it should have a maximum strength, for pearlite is the strongest constituent of carbon steels.

Mr. Keep appears to have a different opinion, for he considers that combined carbon has no influence except to weaken cast iron. Probably this gentleman based his judgment on the effect of massive carbide and not of the fine plates of carbide in pearlite.

Professor Howe considers air furnace melting superior to cupola melting on account of the decarburisation which occurs in the air furnace first, and which is unusual in the latter.

Mr. Guy Johnson, Embreville, Tennessee, in a paper read before the Iron and Steel Institute, in 1898, on the action of metalloids on cast iron, gives a large number of correlated chemical and mechanical tests of Embreville iron, from which the following approximate conclusions may be drawn :—

* From a paper read by Mr. J. E. Stead before the Cleveland Institution of Engineers.

Effect of Combined Carbon.

Effect of 0.8 per cent. combined carbon on the tenacity increase = 8.2 tons.

Effect of 0.1 per cent. combined carbon on the tenacity increase = 1.00 tons.

Effect of Phosphorus.

Effect of 0.43 per cent. phosphorus on tenacity decrease = 2.2 tons per square inch.

Effect of 0.10 per cent. phosphorus on tenacity decrease = 0.51 tons per square inch.

Effect of Silicon.

Effect of 1.45 per cent. silicon on tenacity decrease = 4.1 tons per square inch.

The decrease was not proportional per unit of silicon. For instance, 1.27 per cent. silicon in a pig-iron gave a tenacity of 12.5 tons, 1 per cent. having reduced it by only 1.6 tons.

Effect of Sulphur.

Apparent effect of 0.12 per cent. sulphur on tenacity increase = 3.6 tons.

It is evident that the increase in strength is not due to any direct beneficial effect of sulphur, but to its influence in making a much closer grained iron.

Drop Tests.

Above 1.5 per cent. silicon rapidly reduces resistance to sudden shock.

More than 0.30 per cent. of phosphorus rapidly reduces resistance.

Sulphur has little effect upon the resistance of the metal to shock.

Chill Tests.

Phosphorus had no effect in producing variations in the depth of the chill, but the chill on the iron with 0.18 per cent. phosphorus extended into the grey by fibres, whilst 0.875 per cent. gave a chill sharply separated from the grey portion.

Effect of Melting in Cupola.

Mr. Johnson gives 15 tests showing the effect of melting iron in the cupola.

It would appear that the silicon was reduced between 0.15 per cent. and 0.30 per cent. by melting, and the sulphur increased by about 0.04 per cent.

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MESSRS. SCRIVENER, BREFFIT & COMPANY have removed to Bute Chambers, 103, Bute Street, Cardiff.

THE POWER PLANT CONSTRUCTION COMPANY have removed their offices to Chancery Lane Station Chambers, 31-33, High Holborn, London, W.C.

FOUNDRY COSTS.*

BY RALPH BOWMAN.

In analysing production and in ascertaining the cost the problem *per se* is the same with all foundries, but the method must differ with each individual foundry. This is caused by the difference in castings and the varied nature of each foundry's business. There are three divisions in foundry cost to be considered :—

1. The material, or metal, composing the cupola charge.
2. The general expenses and supplies.
3. The actual moulding time of the moulder.

The first and third divisions, the material and moulding labour, show in themselves what they are. The second division consists of overhead charges, such as taxes and insurance, or rent, improvements and repairs; contingent or sinking funds to cover depreciation; losses through bad debts, etc.; direct charges, such as foreman's wages, wages of cupola tenders, core makers, cleaners, general labourers, and the moulders' time cutting sand and pouring metal; and also the supplies, sand, facings, riddles, shovels, crucibles, flasks, etc. These divisions having been made and that cost ascertained, the cost of castings may be found in the following manner :—

The three divisions are added together and from this sum is deducted the value of the scrap, etc., recovered in gates, sprues and pig bed. Into this remainder is then divided the total number of pounds of good castings, and the result is the cost per pound of the product.

On the other hand, the first two divisions (that is, the cupola charge and the general expenses and supplies) may be added together, and the value of the scrap recovered is then deducted from their sum. This remainder may be divided by the number of pounds of good castings, giving thereby the cost per pound of the metal in the castings. The cost of each individual casting is then found by multiplying its weight by the metal rate per pound, and adding to the result the moulding time of the moulder spent on the casting.

Small and light castings would quite likely take the first method, while large, ponderous and heavy castings would very likely take the second. Therefore the rules for figuring foundry costs cannot be laid down in a hard and fast manner, a

* Paper read before the Buffalo Foundrymen's Association.

foundry's individuality and the information it desires necessarily qualifying the method and the form of analysis.

Again, it is debatable to what exact account many items of foundry costs should be charged. General officers' salaries, for instance, may be considered a part of the selling expense. Plant depreciation may go into general expense, or it may be deducted from net profit, the result being called actual profit. This scheme is frequently all right for a big manufacturing plant, but generally it proves quite wrong for a jobbing foundry. Depreciation may also be taken care of by a sinking fund. Depreciation is an item which many times lack consideration, and its disregard cannot be too strongly condemned.

Depreciation should be taken care of at every closing of the books. Plants will deteriorate, and machinery, kept even in the best order, will sometimes become obsolete by reason of improvements. The owner, therefore, who does not take this item into account gives his business at one time credit for more than it is actually doing, and at another time is unjust to it when the loss falls in one jump, while on the part of a company it is manifestly unfair to ask future stockholders to assume such burdens, to cover which a portion of the former dividends should have been retained.

Other overhead expenses, such as losses through bad debts, also deserve consideration, and should be arranged for much in the same way as depreciation.

Under direct charges, while new flasks are quite properly charged to plant improvements, repairs to flasks, or flask renewals, although taken care of to a certain extent by depreciation, ought to be charged to the metal. They are really supplies, for flasks are used up like files, some portion being taken by every casting. Again, it may be correct to charge the flask directly to the job for which it is made.

Another debatable item is core making. As a rule, however, the cost of cores is put into general expense, for it takes a very expensive core indeed to make an appreciable showing.

If it is a matter of actual moulding, theoretically the labour should be charged directly to the job, but this is frequently found impractical where the castings are comparatively small and of great variety. Dividing the castings into classes, such as light and heavy, or light, medium and heavy, and keeping track of the moulding labour on each class, frequently produces satisfactory results. The results from the latter scheme, though, should be checked from time to time by comparison with the cost of actual moulding labour on individual castings.

This is the idea in general of figuring foundry costs, but, of course, any business analysis cannot end with costs. The question of profit and loss is to be considered. The cost of the product being known, the cost of the sales is therefore known. The cost of the sales being deducted from the sales, the gross profit appears, and by deducting the selling expense from the gross profit, the net profit is shown.

There is also much to be said of the value of a foundry's analysis outside of the bare knowledge of the cost of its product. The results of different formulas of cupola charges, for one thing, are read like a barometer. The labour must account for itself. The expenses tell their own tale. The coke shows how many pounds of metal each pound of it is melting. The leakage appears. Defective castings cannot be hidden. All kinds of moulding comparisons are made. Patterns come in for criticism and are sent to the pattern shop for more draft, to have corners rounded, to be shaped differently and parted in another way so as to save cores, and for all kinds of repairs and improvements. It is not speaking too strongly to say that a foundry manager can sit in his office and learn from analysis what is going on even better than if he stood out in the foundry.

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MESSRS. J. L. CARTY & COMPANY, 219, St. Vincent Street, Glasgow, have been appointed sole agents in Scotland for Messrs. Pierson & Company, engineers, St. Dunstan's Hill, London.

THE SHEFFIELD STEELMAKERS, LIMITED, have introduced a new steel on the market, called "Unor universal air-hardening steel." In tests made with twist drills of Unor steel on a railroad tire made of Cammell's steel of 0.49 per cent carbon, 49 holes, each 15-32 in. in diameter and $1\frac{7}{8}$ in. deep, were drilled at an average speed of 25 seconds each.

THE Standing Joint Committee of the Midland Chambers of Commerce have issued a report on their negotiations with the various railway companies with regard to their interpretation of "owners' risk" consignments. The committee are not satisfied with the companies' replies and are presenting a case to the Board of Trade under Section 31 of the Railway and Canal Traffic Act, 1888.

MOULDS FOR STEEL CASTINGS.

By W. Peters.

It was with much interest that I read the article by W. A. Herron, published in the October number of the Foundry Trade Journal, as from actual observations I can endorse all that he states in so able a manner, and, as he says, the

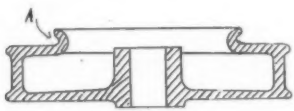

Fig. 1.

trend of the times is strongly in the direction of increased power and strength, and the only material at present available to meet these demands is steel.

Although the manufacture of steel castings has been going on for many years, it is only comparatively recently that their adoption has become so general. No doubt this is accounted for by the fact that good, sound, flawless steel castings have been the exception rather than the rule, and especially is this so as regards small and intricate work, and through this cause malleable cast-iron has been fostered in preference.

Owing to the steadily increasing knowledge of treating the, shall we say, vagaries of steel, the percentage of wasters is decreasing considerably, and, consequently, the cost of production is reduced accordingly; so much so that even malleable castings are now being

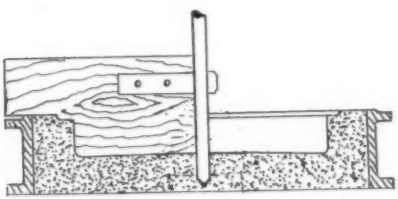

Fig. 2.

gradually superseded. Not only do the steel castings compare very favourably, but they are produced in a much shorter time, as it is quite possible to have them ready for use the day after they are cast, and in some instances, where no annealing is required, on the same day. This in itself is a great advantage over malleable in these days of hurry and bustle.

The introduction of what is known as the "Tropenas" system, which is simply a modification of the Bessemer process, has also tended to develop the steel-casting trade, and, as the working of the system becomes more generally known, still greater developments may be expected; it therefore behoves all who are interested in the foundry business to learn as much as possible about the behaviour of steel castings.

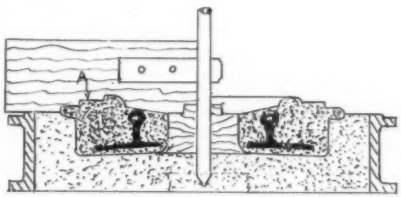

Fig. 3.

As I have already received some excellent information from the Foundry Trade Journal, I think it only right to impart something in return which I hope will prove useful to some of your readers.

As one would expect, there is a wide difference between the making of moulds for steel and iron castings, but in the moulding itself there is a similarity common to both, although in no case that I am aware of is the usual method of loam moulding advisable, as the bricks used in building up prevents the necessary "collapsability" required in order to allow for the excessive shrinkage. At the same time, it is quite possible to make moulds without patterns, although the scope may be somewhat restricted.

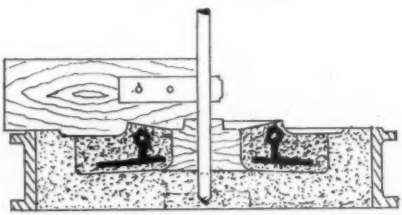

Fig. 4.

The following example of how a pulley for a dynamometer was actually moulded will serve to illustrate how, in a number of cases, this can be done. As there was only one required it is obvious that making a pattern would be the last resource, so it was decided to sweep it up in what is technically termed "compo," on the loam moulding principle, and dry it afterwards.

Fig. 1 is a section of the pulley as required. Figs. 2, 3, 4, 5, 6, and 7

show the different stages of construction. It will be noticed that four different sweep boards are shown as being used, but in practice only two boards were required. The sweep edge for No. 3 was cut out of the top of No. 2, and so with No. 4, which was cut out of No. 6.

The method of construction was as follows:—The spindle was fixed in a plate

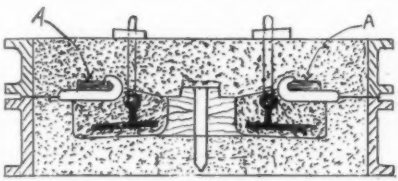

FIG. 5

secured to the bottom of the moulding box; the board attached to the spindle sweeps out the hole to the shape of the inside of the pulley, as shown in Fig. 2. The board is taken off and a wood boss with core print of the required size is placed over the spindle. This mould then forms the bottom portion of a sand core box. No. 2 board is then replaced in the inverse position, and after preparing the mould with parting sand it is then filled up. A round plate with four eye-bolts attached is rammed up with this core and a plentiful supply of cinders bedded in the centre. Care must be taken to have this core as refractory as possible, and the outer edge of the plate as far from the pulley rim as is consistent with safety. This is to allow the core to collapse with

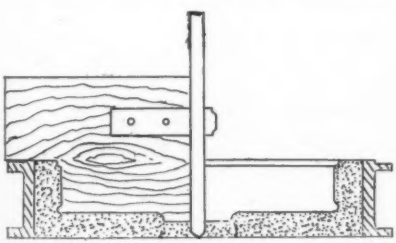

FIG. 6.

the least opposition, to obviate the tendency to fracture, owing to the great amount of contraction incidental to steel castings. The reason of having the board cut out as shown will be seen by referring to Fig. 5. The recess A, Fig. 3, is cut away to form a print for the seating of the core, which forms the overhanging lip marked A, Fig. 1. This core is made in six segments. After sweeping the mould, as shown in Fig. 3, the board is again removed, parting sand is scattered all over, and the mould treated as if a wood pattern was bedded in. The cope is then placed on, rammed up in the usual way, lifted off, and turned over; the lip cores are now fixed in position and the cope put on one side until after the next operation. This is shown in Fig. 4. The second board is now fixed on the spindle and it sweeps up what will be the top part of the main core. This board is then removed, and the cope is again placed in position, wires being led through it from the eye-bolts in the main core and fastened on the top. The cope, with core attached, is then removed, the centre core is fixed, and as this completes the operation, so far as the cope is concerned, it is ready for finishing and drying.

The inside of the drag is now cleared out, and the second board is fixed with the edge down to sweep the shape of the out-

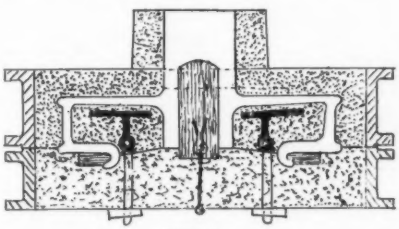

FIG. 7.

side of the pulley, Fig. 6. The sweeping operations are now finished, the spindle and board removed, and a hole, the diameter of the facing, is then cut through the bottom. The whole of the mould is now put into the stove, and care must be taken to have them thoroughly dried. When this is done the cope and drag are cottered together in the reverse position to what they were in the first instance; the reason for this will be seen on referring to Fig. 7. The preparation for the head is now placed over the hole previously cut in the mould. The head should be about 10 in. long, and the top of the centre core rounded off, as shown, to allow for the free flow of the metal which is poured through the head.

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THE steam turbine business of Willans & Robinson, Limited, is developing rapidly. We understand that a friendly arrangement has been entered into with Messrs. C. A. Parsons & Company, and the company has taken a licence enabling it to work under the patents of the Hon. C. A. Parsons.

THE BRYAN VACUUM MOULDING MACHINE.

THE name moulding machine, as applied to all so-called machines, is somewhat of a misnomer, as they are generally merely used to draw the patterns. Such is the case with the machine made by the Bryan Vacuum Moulding Machine Company, Lockport, U.S.A. This machine was designed for the purpose of increasing the rapidity and certainty with which perfect moulds may be set up. Most machines of this character either drew the pattern downward while the flask remains stationary or raise the flask upward while the pattern is stationary. In either of these

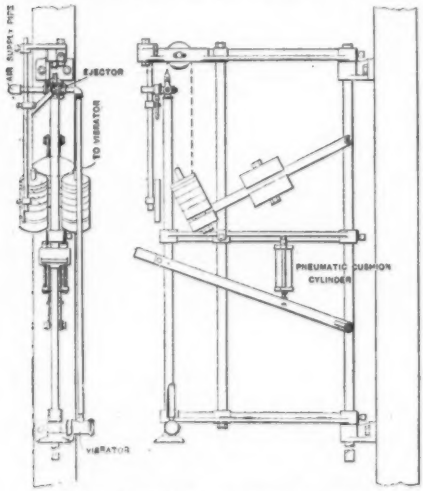

FIG. 1.—TWO VIEWS OF THE BRYAN VACUUM MOULDING MACHINE.

processes there is a tendency for the mould to break, due to the weight of the sand combined with the suction occurring when the pattern is withdrawn. It was, therefore, deemed preferable to reverse the order in the Bryan machine, and the pattern is lifted from the sand while the flask remains stationary, practically as it would be done by hand. It is quite evident that the mould is much less likely to be broken even if the sand should be a trifle dry.

The machine, as may be seen from the illustrations, is intended to be mounted upon a post or wall, and is generally arranged so as to serve two moulders, as it is required for only a part of the work, and may be used alternately by the two operators without their interfering with one another. As shown in Fig. 1, the machine consists of a framework swivelling on brackets secured to a wall or suitable upright over the moulders' bench. This frame supports at its outer end a hollow rod which is movable vertically and carries at its lower end a flared cupped disc having a rubber ring on its lower face. This disc connects through a hollow rod with apparatus for exhausting air. The whole moving part is counterweighted, and may be raised and lowered by means of the handle shown in the view to the right in Fig. 1. The suction device is the part used to withdraw the pattern. It is usually fitted, as illustrated, with a vibrator near the sucker head, which loosens the sand from the pattern while the latter is being fitted.

The most original feature of the machine is an air ejector, by the use of which a vacuum is created in the hollow rod through the agency of compressed air, the principle of its action being similar to that of a steam injector. It takes the place of a power-driven or foot-power vacuum pump, and can usually be employed, as most foundries are supplied with compressed air. This air ejector is a part of the three-way cock at the upper end of the sucker rod. The plug in the three-way cock is arranged to receive an inner pipe connecting to the passage that leads to the hollow sucker rod. Between the inner pipe and the plug cavity there is an annular space, and the plug has two holes opposite each other in a line with the air supply and vibrator discharge passages. When the plug of the three-way cock is turned so that the holes in the plug are in alignment, compressed air is admitted to the annular space, while a small percentage goes through the discharge passage to the vibrator. The balance of the air is discharged through the annular space and exhaust pipe to the atmosphere, creating a vacuum in the hollow sucker rod. The ejector is operated by moving downward the lever attached to the sucker rod, causing the three-way cock lever to strike a lower tappet pin, which is secured to a rod held rigidly by the frame of the machine. This causes the plug of the three-way cock to slightly revolve, admitting compressed air, which passes rapidly over the sucker rod through the plug to the vibrator. When the sucker rod comes in contact with the pattern a vacuum is maintained until, when the pattern is raised, the lever of the three-way cock strikes an upper tappet pin, rotating the plug in the opposite direction to its first movement, shutting

off the air and breaking the vacuum. A vacuum of 21 inches may be maintained with the air ejector when supplied with compressed air of 60 to 75 pounds pressure. This is capable of lifting a weight of about 140 pounds.

Either snap or fixed iron flasks can be used with the Bryan machine. The fixed

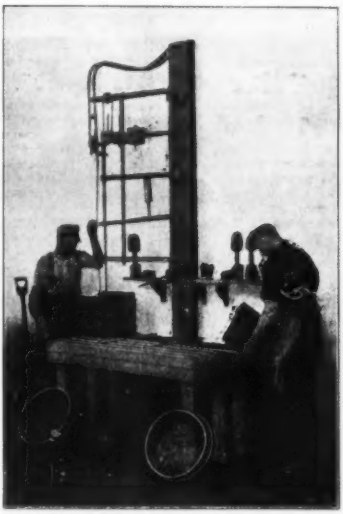

FIG. 2.—THE MACHINE ABOUT TO LIFT THE PATTERN.

flasks, however, are preferable, as they retain their shape and are more durable. Patterns such as are used with this machine, it has been found, cost on an average about 32s. a set in America, or half that amount if the pattern is symmetrical on both sides of the parting line, in which case the half pattern may be used in both the cope and the drag. A pattern of the latter sort is provided with a removable dowel pin, which is removed or replaced as required, in order to match the two parts of the flask. The patterns are mounted on boards, but it is claimed that this extra expense is soon saved in the decreased weight of the castings made with the machine, as they are more nearly the size of the pattern, there being no necessity for excessive rapping to release the pattern.

Figs. 2 and 3 show the way in which the Bryan machine is used for withdrawing the pattern from the mould. The work before the machine comes into play is precisely similar to ordinary hand moulding. The pattern board is placed on the mould table with the pattern up and the flask is placed over the pattern. Perfect alignment is assured by pins in the mould board and corresponding holes in the flask. Facing sand is next sifted over the pattern, and the flask is then filled with regular moulding sand, this being either hand rammed or pressed by a power-driven press. The sand is then levelled off to the height of the flask, a bottom board is placed upon it, and the whole is turned over by hand, bringing the pattern board on top. This is the stage that has been reached by the operator at the right in Fig. 2. The pattern, after being jarred, either by a mallet or the pneumatic vibrator, is then ready to be withdrawn. This operation is being performed by the left-hand operator in Fig. 2. He next grasps the sucker rod lever, and with a downward movement brings the sucker head in contact with the pattern board at about its centre. The sucker rod is then released, as shown at the left in Fig. 3, and the counterweight lifts the pattern from the mould and ascends until the point is reached where the vacuum is broken, releasing the pattern, which is then taken care of by the operator. The operator at the right in Fig. 2, is about ready to use the machine, and the other is just finishing with it, and will swing it within his reach. The machine may be fitted with a pneumatic vibrator and a foot-power vacuum pump instead of the ejector.

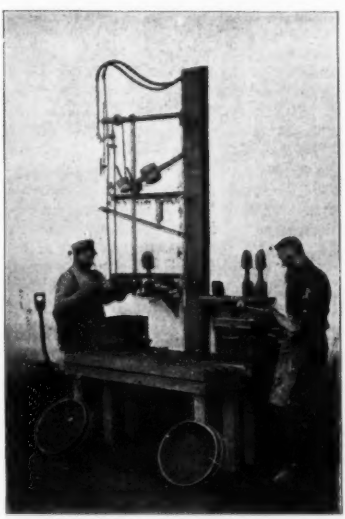

FIG. 3.—THE PATTERN WITHDRAWN AND ABOUT TO BE RELEASED.

BURNING BROKEN NECKS ON ROLLS.

THE writer has read with interest the article by Mr. Shanks in last month's issue. It is a question, however, if work of this kind is not more easily accomplished to-day by the use of "Thermit," and the following account of burning a broken neck on to a roll may be of interest. Thermit is no doubt well known to your readers. It has the disadvantage

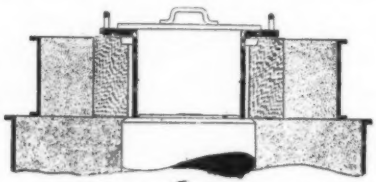

FIG. 1.—TOP OF ROLL READY FOR REPAIRING.

that, ignited on a cold surface, it deposits a layer of slag, which adheres firmly. To avoid this, a thin layer of cast iron or steel is placed on the welding surface before Thermit is placed on it, and to avoid the adhesion of slag at the sides a concentric iron ring is so fixed in the mould that it can be withdrawn after ignition of the Thermit. See Fig. 1.

The method of procedure is as follows: The roll is firmly fixed in such a position that the welding surface lies horizontally. After placing the first mould, which has a diameter exceeding by 2½ in. that of the neck to be welded, a cast-iron ring, with two lugs attached for lifting, is placed in the mould. This ring is ½ in. thick, and stands off about ½ in. from the inner wall of the mould. It is constructed so as to overlap like a flange the upper part of the lower mould box without touching its edge. The inner surface must be well smeared with clay and dried. It must tightly fit the roll, and, where necessary, spaces must be stopped with clay. The flange-like rim of the ring overlaps the edge of the mould, and protects it from any iron which may splash up during the reaction and pouring of the metal.

About 30 lbs. of Thermit are required to the foot of cast-iron surface. This quantity will soften the metal to a depth of about 2 in. For steel rolls, 10 per cent. to 20 per cent. more Thermit is required than for iron. Hot coke placed inside the mould until the iron cannot be touched by the hand is sufficient.

After firmly embedding the ring in the mould box, a thin layer of cast iron or steel, say, ½ in., is poured into it, and must completely cover the welding surface. A thin layer of powdered charcoal can be used instead, but has the objection of producing a spray of sparks. The whole of the Thermit, accurately calculated and weighed, is then quickly added. Very hot liquid steel will ignite it at once but liquid cast iron will not do so, and then Thermit must be ignited in the usual way, viz., a thimbleful of ignition powder is placed upon it in a small heap and lighted with a hot iron. Immediately after ignition, the mould should be covered with an iron lid covered with clay on its under side. The reaction, even with large quantities of Thermit up to 175 lbs. at a time, is finished in half a minute, and the lid must at once be removed and the Thermit stirred with iron rods so as to disturb the slag. The heat of the reaction, even with only 40 to 60 lbs. of Thermit, is so intense that the workmen must protect their hands and faces by using coloured glasses, and covering their hands with cloth.

After a few minutes cast iron or steel is poured out of the ladle, which must be in readiness, into the mould to about a third of its capacity. When cast iron is poured on to Thermit during reaction, it is especially necessary to stir the metal thoroughly, in order to obtain a thorough mixture. A number of stirring rods must

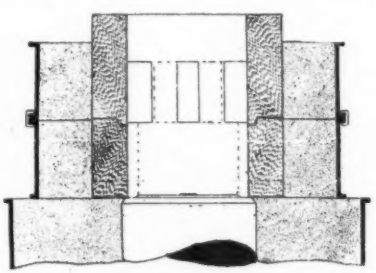

FIG. 2.—TOP MOULD IN POSITION.

be held in readiness, as the heat melts them quickly, until the cast iron is added. Two or three men ought to be employed simultaneously to stir the metal for several minutes, after which the iron ring is lifted out. The whole of the slag will then be found adhering to the inner surface of the ring and is lifted out with it, the ring is protected from melting by the adhering slag and can be used several times. The ring prevents the slag from clinging to the mould itself. After with-

drawing the ring, more iron, constantly stirred up, is added until the lower mould is filled. The remaining slag which will have coagulated in small pieces is carefully taken off before the second mould is placed in position.

If the break is cup-shaped, the hollow which is formed must first be filled with cast iron or steel, upon which the Thermit is ignited. In order to heat up this greater quantity of metal an excess of Thermit over what is stated above must be used. Such hollow breaks could not be repaired by the old method of running metal over them. If the break is very slanting, part of the roll is knocked off to obtain a fairly level surface, but there is no need to have it absolutely horizontal.

Cast iron or steel rolls can be repaired in this way, and a cast-iron neck can be burnt on to a steel roll or a steel neck on to a cast iron one. Rolling mills being as a rule unable to obtain liquid cast iron easily, the latter application is of special interest to them. They need not send the broken roll away, but can repair it in their own shops with liquid steel, and avoid the stoppage of work often necessitated by a broken roll.

It has been calculated at several plants having this method in use that the cost is barely half that of the old method, even when the iron overflow can be utilised economically. Some works have carefully tested the strength of such Thermit welded rolls. Drop tests have proved that breaks occur outside the welds. Test bars cut out of the rolls always fracture a long way from the weld. Of course, all solid pieces of metal can be repaired in exactly the same manner as described for rolls.

Repairs to be effected on castings of less solid construction are more difficult, as, in consequence of the strains that exist in every piece of cast iron, breaks occur near the welds. This is particularly the case in repairs of cast-iron boilers, pipes, cylinders, or pulleys. Even with such shapes a favourable result may be obtained by first annealing the whole piece. In the case of small welds on cast iron, care must be taken to add further quantities of the liquid cast iron; as a mixture of cast iron and Thermit, or its resulting iron, in the proportion of 10 to 1, would produce a hard, unworkable steel, it is necessary always to use 15 to 20 times more cast iron than Thermit. The thorough mixing of the metals must be most carefully watched. The iron ought to run from a good height out of the ladle, and the stirring should be done thoroughly.

PATTERNS FOR COLUMNS, PIPES AND CYLINDRICAL WORK.

(By a Practical Student of Foundry Practice.)

When a foreman or a moulder who has been accustomed throughout his whole experience to the use of split or jointed patterns for columns, pipes, and general cylindrical work, finds himself in a shop where all such patterns are made whole, he naturally has to change his methods somewhat, and reconcile himself to the different practice of that particular shop. It comes natural to those employers, foremen, and moulders who are accustomed to the one method only, to regard that particular method and practice as the cheapest, best, and most satisfactory, despite whatever may be said to the contrary.

Assuming we have an order for a lot of columns, 15 ft. by 15 in., tapering to 12 in., and the firm decides to have a solid or whole pattern, the timber selected is pitch-pine, solid, and measuring 17 ft. by 18 in. This may cost anything from £2 10s. to £3 10s., and weigh several cwt.; it is turned up to requirements, and delivered into the foundry.

The advantages claimed are that the pattern costs less to make, remains straight, requires little repairs, and gives better joints on castings.

The disadvantages are its original first cost, viz., £2 10s. to £3, against 25s. to 30s. for timber required to build up a split or jointed pattern, and its weight, which requires a crane or a half-dozen men to lift it about. It has to be rapped or loosened through the top part to ensure a clean lift, and it has to be bedded down into the sand with the assistance of a 14-lb. hammer and a piece of hard wood to avoid excessive damage to the top of the pattern. The top side of the pattern ultimately becomes damaged with use, which makes more finishing for the moulder. At all times such heavy patterns require the use of a crane to draw them from the sand. Should the moulder have a bad lift with his top part, his pattern must be placed on again for the purpose of making good the damage, and if he gives his pattern much rapping while in the top part he will probably have trouble. At all times these heavy patterns require extra labour in handling, which may be avoided by having lighter timber and building them up in two halves.

If the pattern for this column was made up in two halves, it would be built up with cheaper and more suitable timber than

pitch-pine. It would be about half the weight, and each half pattern could be handled easily by a couple of men. It would cost less for turning, and flanges, etc., could be fixed easier and more secure. The pattern need not be damaged in bedding down in the sand, as there would be no necessity for touching the face of the pattern with a hammer; the castings would be straight; the joints would be as good, and probably straighter, than with a whole pattern, and the writer knows from experience that the average moulder takes more care with a split or jointed pattern than with a whole one.

The writer is fully aware that many firms have a large stock of whole patterns for columns, pipes, etc., and cannot be easily persuaded to discard these patterns entirely, and, doubtless, few foremen would advise such a course.

Being in charge of a foundry where jointed or split patterns were conspicuous by their absence, the writer persuaded the firm to try the experiment of having a column pattern made in two halves. They did so by having a solid piece of pitch-pine cut through the middle, planed, jointed, and finished in the usual way. The result was a foregone conclusion. As soon as the pattern had been in the sand a time or two it began to warp and get out of shape, and before the job was completed there was a clearance of $\frac{3}{8}$ in. at the joint in the middle of the pattern.

The common method of making special pipes up to any diameter, such as bends, elbows, tees, and other designs, is to have a skeleton pattern with a few half-circle pieces nailed on, and the rest made good with sand. Even this class of pattern, if time will allow, is much better made in two halves, especially when there are bends of large diameter. The advantages of having the pattern in two halves enables one to keep the pattern straighter and truer. It is lighter to handle, costs less for repairs, and gives better joints on casting. Sometimes an awkward-shaped pipe is wanted with several bends and angles in its construction. To make a core-box is out of the question, and the core cannot very well be struck up in the ordinary way, owing to the number of bends and angles. There is the alternative of making the core in a dummy mould, or, if the pattern is in two halves, it can be struck up on the joints of the patterns, allowed to stiffen, and then removed from the pattern into the core-oven for drying. In a pipe of this description a jointed pattern makes much the best job.

The methods of moulding and pattern-making vary in different towns and districts, and it is not always an easy matter to upset a man's pet ideas, however antiquated and unsatisfactory they may be. The writer has had sufficient experience to justify him in claiming that the most satisfactory method of making patterns for columns, pipes, and general cylindrical work is to have them built up with seasoned timber and jointed in two halves. The original cost will be less, they will remain straight, cost less for repairs, give less trouble and work in the foundry, and ensure a good joint on the casting.

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The Southern Engineering Company, of Dublin, have opened an establishment at 20, Marlboro' Street, Cork.

The Lister Electric Manufacturing Company, Dursley, has purchased the entire business of Headley, Limited, of the Moresk Mills, Truro.

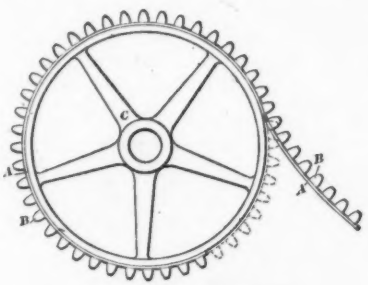
The berths in the new portion of the shipbuilding yard at Sunderland of Messrs. W. Doxford & Sons are surmounted by powerful lattice work erections, and are fitted with overhead trolleys for lifting material into position.

The old forge at Kilnhurst, which for a period of eighteen years has been lying idle, is the scene of a new venture by John Baker & Company, Limited, of Brinsworth, Rotherham. During the last eighteen months the place has undergone a complete transformation. A 15-ton Siemens' open-hearth steel furnace has been put down, and in connection therewith there is a steel foundry. Hydraulic presses will be brought into use for the manufacture of axles and other material, and from the tyre rolling mill a large output is expected. A mill for the rolling of disc wheels has also been put down.

The members of the South Staffordshire Ironmasters' Association held their annual meeting recently at Birmingham, Sir Benjamin Hingley, Bart., presiding. The annual report and statement of accounts were adopted. A suitable call to cover the current year's expenses was made, and the Rating Committee and Railway Committee were appointed. Sir Benjamin Hingley, Bart., was re-appointed chairman for another triennial period. Mr. Tryon, of the firm of Saltmell, Tryon & Saltmell, of London, attended, and explained the position of his negotiations with the railway companies serving the district on the questions of demurrage and warehouse rents, and the settlement of arrears of charges for demurrage now in arrear. It was agreed to adopt the proposals submitted.

GEAR PATTERNS.

A PATENT has recently been taken out the object of which "is to provide a new and improved pattern for casting gear-wheels and gear-racks arranged to permit the formation of gear-wheel patterns of any desired diameter, shape of teeth, pitch, etc., to insure casting of properly meshing gear-wheels in a very simple and economical manner and without the use of the expensive gear-wheel patterns now employed." The patentee is Mr. T. W. Lowe. The illustration shows a flexible strip with gear teeth as applied to the wheel blank. On the face of the strip A, which is of wood, metal, papier-mâché, etc., are glued teeth B, spaced according to the requisite pitch. The flexible strip A is then placed upon the face of a wheel



GEAR TEETH PATTERN

and secured on the rim by glue or other means to form a complete pattern. The teeth B are made by shaping a stick of wood to represent in cross-section a desired tooth, and this stick is cut transversely to form gear-teeth having a length of face corresponding to the width of the desired gear. It is understood that as the strip A is made of a flexible material, and since the bend under each tooth is so slight that it is practically a straight line, the strip can be readily bent so as to lie smoothly on the peripheral surface of the wheel C, the ends of the strips abutting. It is understood that by the arrangement described patterns for spur-wheels, internal gear-wheels, bevel gear-wheels, and the like, can be readily formed in the manner above set forth and at a comparatively small expense.

THE WORTHINGTON PUMP COMPANY are supplying one condensing set to the Leeds Forge Company, and one Winch condenser to the North-Eastern Marine Company.

BRONZE CASTING IN IRON MOULDS.

MR. A. E. OUTERBRIDGE writes:—The greatly increased density and finer texture of test samples of bronze cast in an iron mould, as compared with similar samples of the same bronze metal cast in a sand mould, is frequently attributed entirely to the more rapid cooling of the metal when cast in the iron mould. I have made very many experiments in this direction, covering a period of sixteen years or more, and the result is that I attribute the phenomenon mainly to what I call "fluid compression."

You may ask what do I mean by fluid compression in this connection? I mean simply this: Certain alloys of metals expand with enormous force at the moment of cooling. It is due to this fact that we are enabled to obtain sharp castings. Pure copper, pure silver, pure gold, etc., do not give sharp castings, because they do not expand greatly at the moment of cooling.

When a bronze alloy is cast in a sand mould, it first fills the mould, and then when pouring has ceased it suddenly expands and forces the yielding grains of sand outwards in all directions, making a larger cavity than before. A skin of cooled metal forms immediately; then contraction of the mass begins to take place, the thick sections cool more slowly than the thin sections, giving rise to "segregation" and to spongy spots or porous places, while the whole texture of the congealed metal is of coarser grain than it would have been if it had been subjected to mechanical pressure when in a plastic state.

When this alloy is cast in a metal mould the expansion at the moment of cooling takes place as before, but encounters the rigid walls of the mould, and, therefore, *fluid compression of the molecules of the metal itself* takes place. The internal pressure is frequently sufficient to cause the fluid portion of the metal to burst through the "skin," formed on the upper surface of an open metal mould, where the casting has congealed by exposure to the air, forming pimples of eutectic alloy, and in some cases long filaments curling over in horn-like shapes are extruded.

On cutting a section through an ingot or casting made in a metal mould, then polishing and etching, it will always be found much denser, more uniform in texture, and much more free from segregation than the same metal cast in a sand mould, while the specific gravity is also considerably higher. Such metal is not necessarily harder than when cast in sand, though the "chips" are quite different in

appearance. It may be likened to the difference in density and fineness of grain observed in a piece of pine wood that has been squeezed in a powerful hydraulic press, as compared with a piece of the same wood not compressed. Metallic alloys which have been subjected to this fluid compression show greatly increased tensile strength. These are facts not generally understood, all having important practical application in the metallurgical arts.

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MOULDING MATERIALS.*

Moulding sands in general must have the following characteristics: They must allow themselves to be moulded up, retaining their shape well. They must be able to resist the pressure of the metal as well as its cutting action. They must be porous enough to allow the gases to escape through them readily. They must be refractory enough to stand the temperature of the metal without burning on or disintegrating. They must be free from substances which give off gases, as, for instance, carbonates; as well as fluxes, such as lime and iron oxide. Finally, the moulding sands must crumble easily after shaking out, so that they may be readily tempered up again.

To go into more detail. In order that the moulding sand may be suitable for foundry work, the particles of sand must possess certain required properties. They must be as rough and angular as possible, and not round or smooth. The water used for tempering acts as a binder to some extent, and must be replenished as it evaporates. The moulder judges this by the feel of the sand. If the sand is not porous enough, this water on being brought in contact with the molten metal, and turning to steam, is forced to pass through the body of the metal, causing it to boil, and always makes trouble. Hence the necessity of copious venting occasionally with some sands.

The two properties of sand, to be plastic enough to mould up well, and at the same time to be quite porous, are really diametrically opposite, and hard to combine in the same sample. The property of moulding up well is due to a large amount of clay in the sand, making it plastic. This, in turn, makes the sand denser, and less permeable to gases. Experiments have demonstrated that very fat sands, that is with less than 85 per cent. silica, and 10 to 15 per cent. clay, are impervious to the passage of gases, and only when heated up to 575 to 625 degrees Fah., or in other words, "burnt," will they pass the gases in the iron. The finer the sand the greater this difficulty. If fine sands must be used the microscope should be taken to see that the grains are rough and angular. The size, while hard to designate absolutely, should be about one-sixth of an inch in diameter (which would seem a little large). Finally, the sand should be as uniform as possible in the size of the grains and be free from dust. To test the permeability of sand for gases, the samples should be put into suitable receptacles, pressed equally hard, and then brought to equal dimensions. Water is then dropped on with a graduated burette. The sand which takes up the most water will be the one which passes the gases best.

A sand must keep its shape when the hot metal strikes it. If the sand cracks up in its grains and goes to dust there will be trouble. Thus the sand may contain carbonate of lime, which decomposes under heat. Or there may be hydroxides which disengage water and destroy the integrity of the material. Finally, there may be hair cracks in the grains of quartz which have moisture in them. When the hot metal strikes these, they fly apart. In any of these cases the presence of the proper amount of clay will not give the desired results otherwise obtained.

For heavy pieces of work, or for steel, a sand is used which has more clay in its make-up. In fact, it is a clay which would shrink too much on heating, and hence has added to it quartz, burnt clay, ground crucibles, and the like. Here the shrinkage of the clay portion creates hair cracks which, however, are not continuous, as the grains of sand or other material breaks their continuity. The result is that no trouble is experienced from that source and the gases can pass off all right.

For loam work, the material used shrinks very much, and hence it is necessary to add some organic matter as a binder to counteract the deleterious shrinkage effects. Short straw, cow-manure, calf's hair, increase the binding power, and when baked the mould will pass off gases all right. Sea-coal dare not be used as a facing, as the gases formed are too voluminous, and could not get away. Hence graphite or coke dust is used for the wash. The more sand is found in the loam, the less graphite or coke dust may be used, and *vice versâ*.

* Translated for the "Foundry" from "Eisenzeitung."

FOUNDRY COST ACCOUNTING.

At a recent meeting of the Philadelphia Foundrymen's Association Mr. John A. Makem, of the Evening School of Accounts and Finance, University of Pennsylvania, read a paper on "Foundry Cost Accounts," as follows:—

The subject of foundry cost accounts is a difficult one to handle owing to the widely diversified conditions which exist. It is not the object of this paper to lay out an inflexible method of ascertaining costs, so much as to discuss the principles involved. Cost accounts should be adapted to the business, not the business to the cost accounts. The correct system of cost accounts is the one which dovetails into the financial books, but this is not feasible in the majority of foundries. In fact, it may be said without fear of contradiction that there are many foundries wherein it would be impossible to instal an adequate system of cost accounts. There are, however, various methods of estimating costs, but the words "estimate" and "account" are not synonymous.

When an order is received it is entered in the order book and a serial number assigned thereto. If there be a number of divisions on the order, each division can be assigned a letter. For instance, 500 C would mean the third division of Order 500, and this distinction would follow the pattern and casting; and the moulder or timekeeper should report it in like manner. In small-work foundries, where certain patterns are always in the sand, a permanent order number should be assigned to each pattern, and all the expense should be charged to that order number. The production cost can then be ascertained by dividing the number of units produced during a specific period into the expense charged to the order during that period.

There are foundries wherein it is customary for each party interested to have a small order book in which the order clerk must write a description of each order. The foreman of the foundry, pattern shop, core shop, the timekeeper, the man in charge of the cleaning and assorting, and the shipper all have books. The necessity of re-writing the order so many times is overcome by the use of the hektograph.

Have an order form printed in copying ink on which the order clerk can write a description of the order, the order number, and a rough drawing of the pattern, if necessary, in hektograph ink. As many as twenty copies can be made from one original. Each party receiving a copy should have a squirrel-tail file on which to retain his copies in serial order. If the timekeeper marks on his copy the number and name of the moulder, and, if desired, the price paid after each pattern, it would then be an easy matter a year afterwards, provided his file were carefully preserved, to ascertain how much was paid for a certain pattern on an order.

Patterns.

A number should be assigned to each stock pattern. A card should then be set up for each on which should be recorded the piece-work price of the pattern. This will be a little trouble at first, but you will be amply repaid in the long run. If an internal check is desired, a very good practice used in some foundries is to have two pattern rate cards, both of which must be signed by the foundry superintendent. One set of cards is retained by the cost clerk, and the other set by the bookkeeper. The cost clerk uses the rates on his cards to make his calculations for cost purposes, and the bookkeeper uses his set of cards to make his calculations for pay-roll. The aggregates of both must agree; thus each proves the other's work. This same practice may commendably be followed out for day work rates, and constitutes an efficient check on the accuracy of the pay-roll.

Materials in Foundries.

The first essential to any successful system of cost accounts is a stock account or inventory account. It is a fairly safe rule to follow that if a business will not allow reasonably accurate inventory accounts being kept, showing the monthly variations without a stocktaking, the keeping of cost accounts is impracticable.

Inventory accounts should be kept in as much detail as the requirements demand. Aside from the necessity of keeping accurate inventory accounts for cost purposes, there are other powerful arguments which can be advanced in their favour. When such records are kept, monthly balance sheets may be made. The purchasing agent is always advised as to the movement of materials and thus knows when to order, minimising the possibility of delays in the work owing to delayed deliveries. When employés know such records are kept, it means a reduc-

tion in shop waste, and last, but by no means least, a check is afforded on the use of materials. A manufacturer will look with suspicion upon a discrepancy of fivepence in his cash, yet have absolutely no knowledge as to whether his stock materials are being legitimately used. It may be argued that the proposition is an entirely different one, money leaving no trace behind it and being readily convertible. This must be admitted; but where you have one man who can steal money you have a hundred who can pilfer commodities. The author does not wish to pose as a misanthrope, but experience teaches us that many men are deterred from wrong-doing less by their moral training than by the fear of detection.

form. When the data required by this report are obtainable it is possible to keep cost accounts.

Price Per Pound.

The price per pound used in extending the weights of the castings in the "value" column is obtained by dividing the combined cost of melting materials, fuels, fluxes, cupola labour, and labour and material in repairs, and maintenance of cupola, by the weight of good and defective castings produced during the cost period. This price will change with the change in the prices of materials.

Labour.

It is unnecessary to go deeply into the

HEAT REPORT

HEAT NO.

DATE

CHARGING MATERIALS AND PRODUCT	WEIGHT	CASTINGS MADE					
		ORDER NO.	PATTERN NO.	NO. PCS. MADE	DESCRIPTION	WEIGHT	VALUE
PIG IRON							
SCRAP							
TOTAL CHARGES							
GOOD CASTINGS							
DEFECTIVE CASTINGS							
GATES & SCRAP							
TOTAL PRODUCT							
LOSS							
COAL USED IN CUPOLA							
COKE " " "							

Form No. 1.

If accurate costs are desired, there must be accuracy in recording the items which go to make up the costs. Charging materials must be weighed, as must also the castings and scrap produced. Theoretically, the order should be charged with the weight of the castings, saleable and unsaleable, including the scrap, at the established price of molten metal, and credited with the weight of the scrap and unsaleable castings at the value of scrap; but in practice this is not always feasible.

Heat Report.—Form No. 1.

Form No. 1 is a sketch of a heat report along the lines of those used in some large foundries. Usually it is a pasteboard

subject of labour, because this is one item which, as a rule, is handled in more or less detail for pay-roll purposes. Foundry labour may be divided into two general classes: productive and non-productive Productive labour is sub-divided into two parts: classified and auxiliary. Classified labour is the labour which can be charged direct to a specific order number It includes: Day work and piece work, moulders and apprentices, core-makers, cleaners and chippers, flask-makers.

Auxiliary labour is that labour which is productive in its nature, but cannot be charged direct to a specific order number. It includes: Superintendents, timekeepers, and weighers, labour in handling

materials, engineers and firemen, sand blast operators, tumbler labour gaters, cupola labour, scrap and cinder labour, sand mixing, and inspection. A good method of including the auxiliary labour in the classified labour is to pro-rate it according to the classified hours, with the assistance of a Thatcher slide rule. This is an instrument which is indispensable for work of this character. The term "non-productive labour" needs no explanation.

Form No. 2.—Load and Labour

It will be observed that Form No. 2 is nothing more than a mathematical demonstration. The purpose of the demonstration is to show the different results

FORM NO. 2.

Hours.		Rate. Dols.				Amount of wages. Dols.
2	×	0.10	...	...	...	... 0.20
3	×	.15	...	...	...	... .45
4	×	.20	...	...	...	... .80
5	×	.25	...	...	...	... 1.25
6	×	.30	...	...	...	... 1.80
Total... 20			...	...	...	... 4.50
General expense for period					...	... 4.50
General expense per hour ...					...	... .225

Wages Paid Basis.

Hours.		Rate. Dols.					Amount to order. Dols.
2	×	0.20	...	...	...	...	... 0.40
3	×	.30	...	...	...	...	... .90
4	×	.40	...	...	...	...	... 1.60
5	×	.50	...	...	...	...	... 2.50
6	×	.60	...	...	...	...	... 3.60
			Total		...	...	... 9.00

Number of Hours Basis.

Hours.		Rate per hour. Dols.		Wages paid. Dols.			Amount to order. Dols.
2	×	0.225	+	0.20	...	...	... 0.65
3	×	.225	+	.45	...	...	... 1.125
4	×	.225	+	.80	...	...	... 1.70
5	×	.225	+	1.25	...	...	... 2.375
6	×	.225	+	1.80	...	...	... 3.15
				Total	...	...	... 9.00

obtained by two methods of including the general expense or load, as it is sometimes called, in the labour. The theory is to add to labour a certain arbitrary amount to cover the general expense, which amount is credited to an account against which all the general expense is charged. If your debit balance keeps increasing, it shows you are not adding a sufficient amount to your labour. Whereas, if your credit balance increases it evidences an excessive burden being applied to the labour.

The method in vogue in most manufactories is to add an arbitrary percentage to the amount of wages charged to an order. The other method is to establish an hourly burden which is multiplied by the number of hours worked on the order.

It cannot be seriously contended that a man receiving 10s. per day requires more light, heat, real estate, and more of the foreman's time than a man receiving 5s. per day. The 10s. man will usually require less of the foreman's time than the 5s. man. Hence it is wrong to charge to the order requiring the 10s. man a greater amount of the general expense than to the order requiring the 5s. man.

Form No. 2 shows the different results obtained by the two methods. In the system of pro-rating the general expense over the wages paid, the time of an apprentice is charged to the order at too low a figure, and the time of a skilled moulder at too high a figure. Therefore, your labour records, in addition to showing the amount of money charged to an order, should also exhibit the number of hours worked thereon for the purpose of distributing the load in the form of an hourly burden. It will, of course, involve additional trouble to do this in any case, but especially so in a foundry where moulders are paid piece work.

If you cannot be correct, be as nearly so as possible. If you cannot adopt the "Hours Worked Basis" adopt the next best plan, "Amount of Wages Basis."

It is a mistake to charge the general expense to an order according to the aggregate charges for labour and material, on account of the fluctuations in the prices of materials.

General Expense.—By the term general expense is meant all expense incurred incident to production, which cannot be directly assigned to an order number. It is not the purpose of this paper to dwell on those items of expense with which every one is familiar, such as auxiliary labour not absorbed in the classified labour; labour and materials in repairs and maintenance; tools and supplies, including sands, power and light (electric); steam, miscellaneous expenses. The aim is to discuss that item on which considerable ambiguity exists, viz.:

Depreciation.

Mr. Lawrence R. Dicksee, the celebrated accountant, defines depreciation as "a shrinkage in value which in the ordinary course of events may be expected to

take place as being a necessary consequence of the possession and enjoyment of the asset. It is consequently a charge against revenue." Mr. Arthur L. Dickinson in his paper on "The Profits of a Corporation," read at the Congress of Accountants, St. Louis, last summer, referred to depreciation as follows: "It would be beyond the scope of this paper to discuss what the different rates of depreciation on different classes of property should be; but it is necessary to emphasise the fact that however long the life of the buildings or plant, and however much may be spent year by year in the actual upkeep thereof, there must be a gradual depreciation in the value due either to direct wear and tear, or to the necessity of replacing old and obsolete articles by new and up-to-date ones. It is probable, however, that in any going concern which is maintained in an efficient condition, there is a limit to the total amount of this depreciation as between original cost and present value. In fact, the theory that any piece of machinery continues in use until it reaches an absolute scrap value is not in accord with practical experience, taking any plant as a whole. When a plant is entirely new, it may be properly considered as being worth its cost. It will never again attain this standard, because never again will the whole of it be absolutely new. On the other hand, it can never fall below a certain percentage of this standard without becoming so inefficient that it could not be operated at all. Between these limits, therefore, would seem to lie the total amount of depreciation to be provided out of earnings over a long period of years, assuming that all renewal expenditures tending to increase the life of the plant are charged against the depreciation so provided. It is submitted that perhaps the most satisfactory way of making such provision is, in the first instance, to estimate the life of the different assets, assuming that ordinary recurring maintenance and renewal charges are provided out of profits as they occur, and to set aside each year the corresponding proportion of the original cost, crediting the same to a depreciation fund. From time to time expenditures which may be termed 'extraordinary renewals,' or 'periodical renewals,' will require to be made, which from their nature increase the original life of the plant. These should be charged against the fund provided. In this manner an equitable charge would be made against earnings each year to represent the amount of wear and tear that has accrued during the year. In many cases, in place of a basis of life in years, one in tons operated will be found preferable; in which case the charge against profits would take the form of a rate per ton of production, rather than a rate per year of life.

"There are other methods in force for properly providing for this wear and tear; but there is one method which it may safely be stated is an entirely erroneous one, and that is to set aside such sums as the directors may decide upon out of profits of each year upon no definite basis whatever."

The largest items of depreciation to be considered in connection with the foundry are—

Depreciation of Patterns, Furnaces and Flasks.

The actual amount of estimated depreciation must obviously be governed by conditions. Wood patterns, core boxes and flasks, of course, depreciate much more rapidly than do brass or iron ones. It is claimed that 30 per cent. per annum does not any more than cover the depreciation of wood patterns.

The depreciation of an air furnace or a cupola, where the renewals thereto are currently charged to cost, must be decided by each foundryman for himself. It must be admitted, however, that there is a certain amount of depreciation, even though the working efficiency is maintained, as Mr. Dickinson well says. This depreciation, whatever you may decide it to be, is certainly a factor in the cost and should be so handled. The item of furnace renewals is an extremely important one, and all such renewals should be charged to cost where they are not of such an extensive nature as to increase the capacity. It is well to have an inventory of the plant items kept in such a way as to show depreciation deducted, as well as reduced cost in detail.

Miscellaneous Expenses.

The writer had not intended entering upon a dissertation on what items constitute "miscellaneous expenses" further than already indicated, but his attention has been called to a sentence in an article on this subject recently published, on which it might not be amiss to comment. The statement is as follows: "Other overhead expenses, such as losses through bad debts, also deserve consideration, and should be arranged for much in the same way as depreciation." In a jobbing foundry this would be an immaterial error. Where, however, a stock of finished castings is carried on hand and

the bad debts are numerous, the error is a very material one, the result of which is the inflation of inventory values, and the consequent mis-statement of the profits available for dividend.

Depreciation is as much a factor in the cost of production as is the payment for labour and materials consumed. Bad debts, on the other hand, are certainly a charge against the credit or financial department, and have absolutely no bearing on the cost of production. Let us follow the idea to its logical conclusion. Suppose two exactly similar plants are competitors on the same line of work. One of these plants has a poor credit manager, and the other has a good credit manager. The cost of production in the plant which employs the poor credit manager will be higher than in the plant wherein the good credit manager is employed. The absurdity of the premise is self-evident.

Costs of Individual Labour.

In a foundry in which costs are kept on all orders, all materials charged into the cupola or air furnace must be weighed, as must also the castings and scrap produced. In other words, it is essential to secure the data required by Form No. 1 The first procedure is to open up a cost sheet or card for each order which may be ruled to suit the requirements. It must, however, record the following :—

Number of pieces made.
Weight per piece.
Total weight and value of metal.
Labour.
General expense or total hourly burden.
Total of all charges.

In the general ledger should be opened these three accounts :—Foundry burden account, uncompleted orders and completed orders.

The total charges to the cost sheets or cards must represent the total debit in uncompleted orders in the general ledger. When an order is finished, uncompleted orders are credited and completed orders debited. Classified labour is charged direct to uncompleted orders, but the hourly burden applied thereto comes from the foundry burden account.

Foundry Burden Account.

Foundry burden account is a balance account, which shows whether the price at which the metal is being charged to the orders is high enough, and also whether the established hourly burden is sufficient.

In the following list of the debits and credits to the foundry burden account, it will be observed that certain symbols represent certain expense. These symbols are permanent ones, and all expense of the nature indicated by the symbols should be charged thereto. When such records are maintained, it is a simple matter to compute the cost per ton of product of the various expenses, and the management is thereby enabled to keep a closer watch on such expenses.

Symbol.	Description of Expense.	Amount.
	DEBITS.	
	Charging Materials.	
	Pig-iron	.....
	Scrap	.....
	Limestone	.....
	Total	.....
	Miscellaneous Fuel.	
	For core ovens	.....
	For heating	.....
	Total	.....
	General Expense.	
	Power and light (electric) ...	.....
	Steam	.....
	Depreciation	.....
	Miscellaneous expense	.....
	Total general expense ...	.....
A	*Productive Labour.*	
	1 Moulders and apprentices (when not charged direct to orders)...	
	2 Core makers (when not charged direct to orders)	
	3 Cleaners and chippers (when not charged direct to orders)	
	4 Flask makers (when not charged direct to orders)	
	5 Superintendents	
	6 Timekeepers and weighers	
	7 Labour handling materials	
	8 Engineers and firemen	
	9 Sand blast operators	
	10 Tumbler labour	
	11 Gaters	
	12 Cupola labour	
	13 Scrap and cinder labour	
	14 Sand mixing	
	15 Inspection	
	Total productive labour	
B	*Repairs—Labour and Material.*	
	1 Cranes and appurtenances	
	2 Cupolas, fans, and appurtenances	
	3 Core ovens and appurtenances	
	4 Scales	
	5 Annealing furnaces	
	6 Engines	
	7 Flasks	
	Total repairs	
C	*Maintenance—Labour and Material.*	
	1 Yards, fences, sidewalks, etc.	
	2 Buildings and roofs	
	3 Tracks, track scales, trestles	
	Total maintenance	
D	*Tools and Supplies.*	
	1 Miscellaneous supplies	
	2 Molding sands, etc....	
	Total tools and supplies	
	Total debits	
	CREDITS.	
	Lbs. molten metal charged to uncompleted orders at	
	Lbs. scrap produced — not charged to orders direct at	
	Aggregate hourly burden applied to classified labour	
	Total credits	
	Balance	

Form No. 3.

Form No. 3 is a summary exhibit showing the cost per ton of product of the various items enumerated thereon.

Where costs are kept on each particular line of product, the plan just outlined would be applicable, except that the detail is considerably diminished. Instead of recording costs on all the orders of each particular line of product, you only keep records of the aggregate costs of all the orders of each line. A designating symbol should precede the regular order number, evidencing to what class of product the order belongs. Suppose Order No. 500 C is assigned to jobbing work,

COST OF PRODUCING CASTINGS

	QUANTITY	PRICE	AMOUNT	COST PER-TON
PIG IRON				
SCRAP				
TOTAL CHARGES				
MINUS SCRAP MADE				
NET CHARGES				
FUEL				
COAL				
COKE				
TOTAL FUEL				
PRODUCTIVE LABOR (CLASSIFIED & AUXILIARY)				
LABOR AND MATERIAL IN REPAIRS				
LABOR AND MATERIAL IN MAINTENANCE				
TOOLS AND SUPPLIES				
STEAM				
POWER AND LIGHT – ELECTRIC				
MISCELLANEOUS EXPENSES				
DEPRECIATION				
TOTAL COST ABOVE NET CHARGES				
GRAND TOTAL COST OF ____ TONS ____ CASTINGS				

FORM NO. 3.

then put the pattern in the sand as Order J. 500 C. In this way it will not be difficult for the cost clerk to keep his records straight.

Where it is desired to keep costs on new patterns only, the question resolves itself into a method of estimating. It would be unnecessary, in fact, impossible, to keep the three accounts—foundry burden account, uncompleted orders and completed orders. There is one point, however, that I wish to lay particular stress upon, and that is the "labour" account should represent classified labour only. Auxiliary labour, labour and material in repairs and maintenance, etc., should be charged to general expenses. Your records, in addition to exhibiting the amount of classified labour during a specific period, should also exhibit the number of classified hours which the amount represents. It is then a simple matter to establish your hourly burden by dividing the number of classified hours into the total amount of your general expenses. The sufficiency of the hourly burden should be frequently tested, as should also the accuracy of the established price of molten metal.

Where the method of keeping costs on all orders is in use the account "completed orders" embraces all the accounts which usually appear in the manufacturing section of the profit and loss account. Under the system of cost estimating, where the cost of an occasional order is arrived at by charging thereto the molten metal at the established cost, the classified labour, and the product of the hourly burden, multiplied by the number of classified hours, and when crediting it with the weight of the unsaleable castings and scrap at scrap value, the various accounts which make up the manufacturing section of the profit and loss account are not closed out currently into a burden account, and therefore are carried in the usual way to the profit and loss account.

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OBITUARY.

PROFESSOR B. KERL, the well-known German metallurgist.

MR. GEORGE SMITH, ironfounder, of South Shields, in his 61st year.

MR. T. WATSON, proprietor of the Alma Iron Works, Spilsby, at the age of 56 years.

MR. A. CRAVEN, chairman of the firm of Cravens, Limited, railway carriage builders, Sheffield.

MR. J. M. WALKER, for 32 years with Messrs. S. Lawson & Sons, at the Hope Foundry, in Leeds.

MR. H. W. SLANEY, the secretary of the Haslam Foundry Company, Limited, Derby, in his 21st year.

MR. G. C. LLOYD, of the firm of Cornish & Lloyds, Limited, Risbygate, Foundry and Engineering Works, Bury St. Edmunds, at the age of 52 years.

MR. J. PAGE, who was for about a quarter of a century the principal partner in the Monmer Lane Iron Company, Limited, Willenhall, aged 76 years.

THE HEAVIEST CASTING.

Mr. W. F. Bagnall, of Bagnall Bros., Shalesmoor Foundry, Sheffield, writes as follows :—

"I think the following account of casting an anvil block, 210 tons weight, made at the Bolton Iron and Steel Company's works at Bolton, and copied from "Iron and Steel Manufacture," 1867 and 1868, by Ferdinand Kohn, C.E., would interest your readers, and also probably be the answer to the query in your April number, as to the heaviest piece cast in the United Kingdom during the last 50 years or so."

Anvil Block Casting for a 25-Ton Steam Hammer at the Bolton Iron and Steel Company's Works, Bolton.

The anvil block for this steam hammer is probably the largest casting which has ever yet been made in this country, weighing 210 tons in one piece. This block belongs to a steam hammer used at the Bolton Iron and Steel Company's Works at Bolton, made by Messrs. Nasmyth, Wilson & Company. The hammer-head is 25 tons, the stroke 9 ft.

The block is a casting 12 ft. square on the base by 11 ft. 6 in. high, and it was cast at an horizontal distance of 16 ft. from its present site, in an inverted position. The casting was made by the aid of two of Ireland's patent cupolas, and the operation was conducted under the direction of Mr. J. Ireland, who had had great experience in this class of work. The two cupolas used at Bolton had wrought-iron casings 7 ft. in diameter and 22 ft. high, and the charging doors were 15 ft. above the ground level. The furnaces, when bricked up, were 3 ft. 8 in. in diameter across the tuyeres, widened out below to 5 ft. 6 in., and above to 5 ft. There were twelve tuyeres in each furnace—four at the bottom, each 8 in. in diameter, and eight upper ones, each 3 in. in diameter. The blast was supplied from the blowing engines used for the Bessemer process, and it was conducted to the furnaces through cast-iron pipes 15 in. in diameter. The pressure at the furnaces was equal to a water column 14 in. high. In commencing operations, the charges consisted of 50 cwt. of metal to 3 cwt. of coke; and for the first fifty charges from 3 cwt. to 4 cwt. of scrap Bessemer steel were put in along with each charge in addition to the above-mentioned weight of iron.

In the afternoon the proportion of coke in the charges was reduced to 2½ cwt. for the same weight of metal. The two furnaces were each filled with melted iron up to the level of tuyeres before the first tap was made, and throughout the operations the iron was allowed to accumulate in the same manner before being let out. There were runners from the furnaces to the side of the mould where a perpendicular gate was formed down to one of the two trunnions, which were cast on the block. The metal thus ran into the mould through the trunnion; all the metal was run in in this way, and none over the top. The effect of this method of proceeding was that each fresh lot of metal that was run in after the mould had been filled up to the level of the trunnions welled up through that previously poured, and the whole mass was thus kept in a molten state until the mould was full. The total time occupied in melting was 10¾ hours, including two hours of stoppage, during which the blast was shut off. The time actually occupied in melting the required quantity of iron was thus 8¾ hours. The mould was built up of brickwork, lined with loam, and we believe that nothing was placed at the bottom of the mould to break the force of the falling iron. A large quantity of charcoal was put into the mould before pouring the metal, and this floated on the latter, and kept it from chilling. The brickwork of the mould was not removed for a month after the casting was made, although the sand was dug from around it the week after the metal had been run. The block was cast bottom upwards; and after the mould had been removed, and the necessary space cleared, brick walls and bearers were built up under the trunnions already mentioned, and the casting was then turned over on these trunnions, so that it hung bottom downwards. The trunnions are each 1 ft. 6 in. in diameter by 3 ft. long, and they are situated at a distance of 7 ft. 4 in. (measured to their centres) from the base of the block, so that when the latter was in the inverted position, there was a great preponderating weight above them.

After being turned the right way up, the block was moved horizontally 16 ft. into its present position.

—o—

"Ferro" writes :—The heaviest piece that I know of was cast at Glengarnock Iron and Steel Works about fifteen years ago, in the form of an anvil block; its approximate weight was given at 200 tons. The amount of iron charged in two cupolas, erected for the special purpose of casting this block, was given at 220 tons. It was moulded, cast, and turned upside down by the aid of hydraulic jacks, and the trunnions or swivels cast on made this operation a comparatively easy job. The whole affair was done where the hammer was erected.

CASTING CORLISS CYLINDERS.

To the Editor of the FOUNDRY TRADE JOURNAL.

SIR,—It is quite true, as "Subscriber" says, that the many positions of casting cylinders are perplexing, and specially is this the case with those of the "Corliss type." Needless to say, there is really no absolute safety in any position, or guarantee that all the points regarding boring of valves and boring of barrel, etc., will come out as we would like them to be, because no matter what position we choose in casting, the trouble of "dirt," not to mention anything else, will arise.

In the vertical position the "bore" in the barrel is practically safe at all times, but the opposite is the case with the valves, as by casting in this position we put the four valves in the horizontal position—an undesirable one for all cylindrical bodies that have to be bored.

The moulding of cylinders is doubtless regarded by all who know the trade as the castings which have given most trouble in the past, and are likely to do so in the future. Hence the "Corliss" being so much in evidence for a considerable number of years, or the difficulties attending the successful casting of same, the correspondence started by "Subscriber" will doubtless be much appreciated by many of your supporters.

But while this is so, we must not imagine that with the advent of the "Corliss" the moulders' troubles began. And I am inclined to think that with the marine jacketed cylinders the risks involved in casting were far in excess of the worst ("jacketless") Corliss that have, so far as the writer's experience is concerned, been cast.

It is not ancient history to recall the anxiety at the time of casting large or small "jacketed cylinders," and that we stood with bated breath while the metal rose comparatively placid through the risers, a comfort at all times to be desired, because one cough in this class of work at the completion of pouring meant too often the prelude to disaster. Happily for the founder and all concerned, the method of jacketing cylinders in the foundry is almost, if not altogether, a thing of the past, both in marine and land engines. This admitted, as it relates to the steam engine; still, there are lots of the gas engine type makers, but generally of the smaller class, who cling tenaciously to the jacketing of cylinder barrels. But those cylinders are, as a rule, entirely open at one of the ends, consequently the difficulty of getting the castings all right is a small matter when compared with either the light or heavy steam cylinders referred to whose jacket cores were enshrouded or immersed in metal, saving the plug cores at both ends—the indispensable adjuncts for venting and fettling those castings.

But as I find I am getting a little digressive, I must keep more to the subject, namely, "casting Corliss cylinders." Permit me to say my experience of casting those cylinders is a fair one, and the greatest h.p. moulded by the writer would be somewhere between 1,000 and 1,200, and cylinders with weights varying between 20 and 120 cwts., the smaller class being moulded in sand, and the heavier ones in loam.

Dry sand moulds were always cast on the "horizontal," and loam invariably in the "vertical" position, and in no case up to the present has the writer had a single failure. But don't forget that he is not without his failures that are commonly known to all men who mould and cast in a foundry.

Loam being built "vertically," there is no other choice but this position of casting, unless it be as to whether the close or the open end should be uppermost. Here, again, there is room for divided opinion, but I have always chosen the close end for the top, which, as I mentioned before, have always come out as desired. No doubt the close end is preferable at the bottom, but the risk involved make it, in my opinion, not commendable. Hence, with judicious care and a bit of practical stratagem, none need be afraid of failure from the close end being uppermost while casting.

Briefly, the moulding and casting of "Corliss cylinders" are, within certain limits, safer moulded in dry sand when cast in the horizontal position. But those of the larger type, which necessitate being moulded in loam, must be cast vertically. As to which end be uppermost while casting, this is a matter for the responsible party to decide.

Lastly, each man has his own way of gating, both as to speed and position; the variation thus may not mean much vertically, but if cast flat there is nothing more vital. Clearly there is no fixed rule for this as in other matters of detail; suffice it to say, we are at all times controlled by circumstances as to whether we should "drop" from somewhere on the top, cut from the joint, or let the metal in from a "worm" or "fountain" gate further down.

Yours truly,

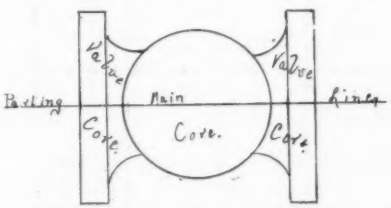
MEMBER OF THE BRITISH FOUNDRYMEN'S ASSOCIATION.

April 22, 1905.

To the Editor of the FOUNDRY TRADE JOURNAL.

SIR,—Will you allow me to thank you for inserting my letter in your valuable journal, March issue, page 122, and also to thank the other two correspondents, "Mr. Charles A. Allen," and "A Moulder," for their valuable information in last month's issue of the FOUNDRY TRADE JOURNAL anent the above question. I have followed Mr. Allen fairly well up to halving of the cores, and as I don't quite understand his meaning here, he might let me know if the sketch as shown interprets his meaning.

The parting line indicates the halving, and, at first sight, seems a very simple



affair, but I have a fear that those cores manipulated thus would get out of line with each other. Therefore, I shall take it a favour if Mr. Allen or any other reader would let me know if the ports at each end of the cylinder are attached to the steam and exhaust chambers on their respective sides, or otherwise.

I may say that I have already referred this matter to one or two practical moulders, but they are like the writer, they do not know as to whether it refers to the halving of the ports only, or the halving of each group of cores on either side, assuming them to be so arranged. Again thanking you,

I remain,

Yours truly,

"SUBSCRIBER."

—o—

KRYPTOL.

WHENEVER there is any resistance offered to the flow of an electric current, a certain amount of electric energy is transformed into heat. The current overcoming the resistance may be made to expend all or part of its energy in doing this, raising the temperature of the conductor a corresponding amount. The amount of heat generated will increase in direct proportion to the resistance of the conductors and to the square of the current. Practically all heating appliances, such as are used for tramways, electric stoves, etc., consist of coils of wire of high resistance through which an electric current is passed. These stoves are but seldom used in the chemical laboratory, and then only for heating inflammable liquids such as ether, carbon bi-sulphide, etc. A new resistance material, however, called by its patentee Kryptol, possesses features which make it possible that electric furnaces making use of it will come into favour with chemists.

Kryptol is a new German invention. The exact method of its preparation is not stated in the patent claims. It is, however, a mixture of graphite, carborundum, and clay so combined as to form a loose granular mass or powder of very high resistance. It is made in four grades, the finest size having the least resistance and the coarsest the greatest resistance. It is not decomposed by any heat less than 3,000 degrees C., and so may be used where circumstances will permit and the furnace is made of sufficiently refractory material for maintaining any temperature from that of the air up to 3,000 degrees C. It is free from dust, and can be used without danger from short circuiting such as is always present in furnaces using metal wire spirals. It can be used on a 110 or 220 volt circuit with advantage.

This process lends itself with great convenience to all the finer smelting operations in scientific and industrial metallurgy. These operations may be carried on by means of a small crucible furnace, which consists of an iron shell with an enamel lining filled with coarse-grained Kryptol, in the centre of which is hung a movable graphite crucible, in which any temperature up to 2,000 degrees Cent. (3,632 degrees Fahr.) may be generated. With a current of fifteen amperes, nickel, the melting point of which is about 1,600 degrees C., may be fused in about six minutes. Some of the steel and cutlery manufacturers in Westphalia are experimenting with Kryptol with a view to its employment for tempering, annealing, and case-hardening steel and iron bars, knives, scissors, and other implements. Such processes would become thereby automatic and independent of the skill of the workman.

—o—

THE new works at East Pilton, of Bruce, Peebles & Company, Limited, which have now been in operation twelve months, are giving every satisfaction to the company. The total expenditure on these works was £93,000, or £40,000 more than was originally estimated.

SELLING PRICES OF GAS AND OIL ENGINES.

THE annexed chart (Fig. 1) has been compiled from the prices of about ten makers of gas engines and of some twenty makers of oil engines, and shows the average price per brake horse-power of English gas and oil engines. In the case of the oil engines, however, the average prices for the powers over 15 b.h.p. are taken from those of some three of four makers, as there are relatively fewer makers of large oil engines. The chart was suggested by a study of a chart compiled by Professor Wm. T. Magruder, showing a comparison of English, German, French, Belgian, and American prices of gas engines, which is reproduced in Fig. 2. It will be seen that for the prices of English engines Professor Magruder's chart and our own agree fairly closely.

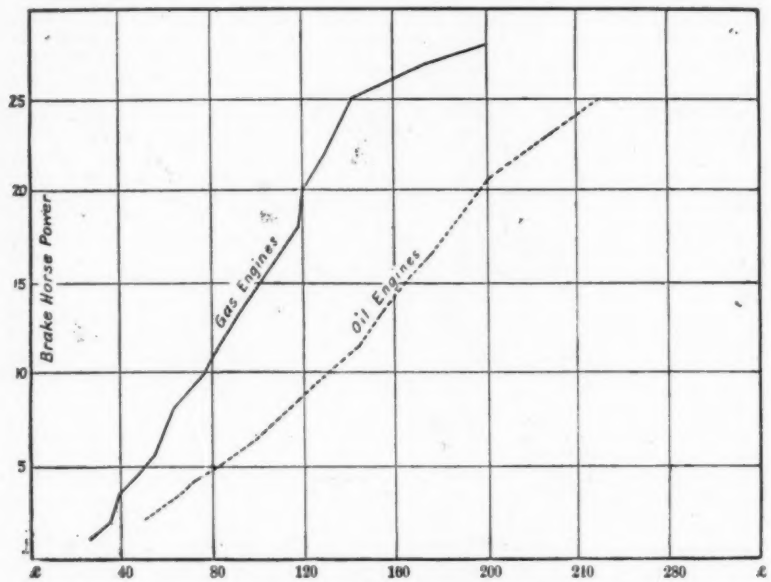


FIG. 1.

The prices are supposed in all cases to cover the engine with its flywheel or wheels, boxed and delivered to the transportation company at the factory, and including the usual collection of wrenches, lubricators, cocks, gas-bags, pumps, hot-tube or electric igniting apparatus, and, in the case of the English engines, the assortment of "spares," or repair parts, which are sent with every engine. For obvious reasons, no names of makers are given, but only the names of localities or nationalities and of the shipping or receiving points. Doubtless the discounts, and also the net price lists, vary from time to time, but it is thought that while the figures given are possibly not all as accurate as might be wished, they are not misleading, and will answer for a comparative investigation of the prices of gas engines.

From a study of the diagrams presented herewith, it will be seen that current net prices in America and England are practically the same for engines of the same grade. With the exception of the Otto Company, at Deutz, the prices quoted by German builders are much higher (50 to 150 per cent.) than those of other makers. This will account for the fact that our English builders are able to successfully compete with the Germans, and to export engines in considerable numbers to Holland and Belgium, whence they are distributed throughout the Low Countries and the Rhenish provinces of Germany. In this they are favoured by water transportation by river and canal to interior points.

It may be interesting to note that, from the data here presented, the quotations on American gas engines of 5 horse-power vary from £10 to £20 per horse-

power; on English engines, from £11 to £17 per horse-power; on Belgian engines, from £20 to £23 per horse-power; and on German engines, from £22 to £27 per horse-power. The quotations on American gas engines of 10 horse-power vary from £7 6s. to £12 per horse-power; on English engines, from £7 10s. to £12 per horse-power; on Belgian engines, from £14 15s. to £17 10s. per horse-power, and on German engines, from £15 12s. to £21 5s. per horse-power. The quotations on American gas engines of 25 horse-power vary from £5 5s. to £8 10s. per horse-power; on English engines, from £5 5s. to £7 5s. per horse-power; on Belgian engines, from £10 16s. to £13 per horse-power, and on German engines, from £8 5s. to £14 10s. per horse-power. It will thus be seen that on the smaller and more common sizes of engines the prices per horse-power vary in all countries, not only with the grade, but with the size of the engine—a fact not peculiar to gas engines. Especially in this country, prices differ by nearly 100 per cent. Hence it is apparent that no quotation or rate per horse-power can be given which shall have any significant value for engines of all sizes and grades.

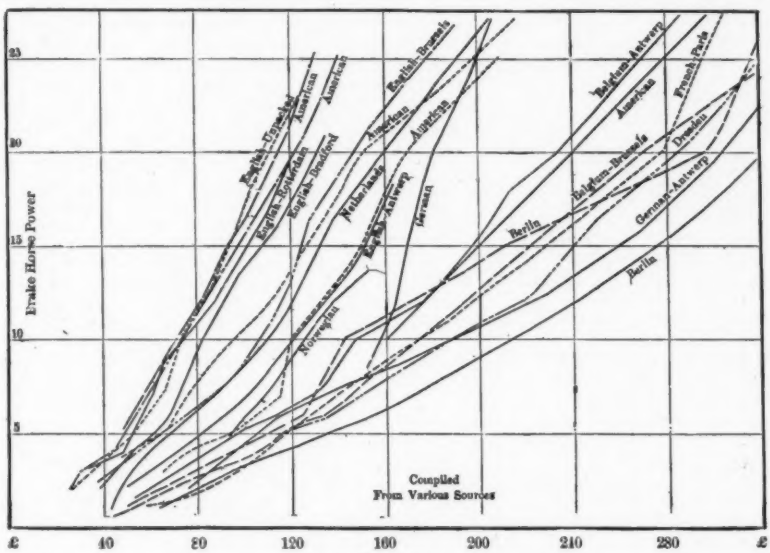


FIG. 2.

THE CARLTON IRON COMPANY have blown in another furnace to produce Cleveland pig-iron.

CORES FOR CYLINDRICAL WORKS.

MAKING the cores for long plungers and cylinder moulds, to be cast on end, is a branch of foundry practice that calls for special attention and for so much different treatment from the ordinary loam core making that a few words on the subject may be of interest. Ordinarily on pipe-work or cylindical work the spindle is wrapped with a covering of hay rope, and on this a covering of clay and fine gravelly sand is applied, and the core at one operation built up to almost the required size; it is then put into the oven, and after being dried is taken out and a second covering (loam and sharp sand wet with clay wash) called the second coat applied, and after this sets a little a coat of blacking is given the core and it is run back into the oven to be dried. So clever does a gang of core makers in a pipe shop become, and so adept in handling rigging and core appliances, that three men will, each day, make complete and place in moulds, ready for the iron, one hundred 4 in. cores, 12 ft. 6 in. long, while four men will make eighty-two 6 in., or sixty 8 in., or forty-eight 10 in. cores of like length each day.

This is for ordinary pipe work where the thickness of castings runs from $\frac{3}{8}$ in. to

1 in. But where hydraulic pistons and cylinders are made, with a thickness of metal running from 2 in. to 5 in. or more, and from a length of from 15 ft. to 30 ft., experience teaches us that the ordinary pipe core will not answer. If we build the core on a spindle large enough to take the hay rope and then the gravel mixture, we will find, if we place it in the mould and pour a large quantity of metal around it, that the extreme heat will burn out the hay rope before the metal has a chance to solidify, and when the contraction or shrinkage commences, it meets but feeble resistance from the consuming core, and as the pressure is greatest at the bottom of the mould the liquid metal feeds away from the top to the point of pressure, thus leaving a spongy or shrunken top, for such moulds are not generally fed either through "churning rod" or "feed head." To avoid all this, we take a spindle, small in diameter, and around this wrap a small ⅜ in. hay rope, winding it tightly and snugly; on this we place a coating of core loam about 1½ in. in thickness, and our core is then placed in the oven where this, our first coating, is dried, then taken out, and we apply another similar coating of core load, and this is also dried, and this process of building and drying, one coating upon another, is continued until a core of the required diameter is produced.

If there are any shoulders or projections on the core, where danger might ensue from metal striking such points in pouring, they are thoroughly nailed, and usually the 3 or 4 ft. of the upper part of the core near the gates are well nailed; a coat of good heavy blacking is then applied, and the core thoroughly dried; it is then ready for casting, and the successive coatings of core loam make a core rigid enough to withstand almost any strain, and the hay rope being so far away from the molten metal, the metal solidifies before the hay rope commences to burn.

The spindle will of necessity be small in diameter, and may be difficult to get into a vertical position with its heavy load of core loam. Usually this difficulty can be overcome by having a hole drilled through the spindle 6 or 8 ft. from the top end, and passing a bar through the opening, and swinging the core from this bar into an upright position, a new hold can then be taken from the top of the core.

When the core is to be of such a length that to make it all on one spindle would be hardly practicable, two spindles are pieced together to make one complete core. When we first thought of doing this, various were the ways that suggested themselves, and some were talked over and tried, and, finally, the simple and successful method now in use with us was adopted. The lower or bottom part of core is placed in a mould, a ridge of flour dough is run around the top edge, and the second core placed on top of the first one, the dough making a tight joint. Care must be taken that the gas can pass readily from bottom core up through top core. When the top core is keyed down no trouble is experienced where the cores meet. Of course, the flask must be jointed above where the cores meet, that the second core may be lowered on the first one, and keyed in position at the mould's joint. The upper part of the flask is then lowered over the upright core. If the mould is lengthy, and the metal has a long drop from the top, a piece of boiler iron cut the shape of the bottom of the mould should be set in the mould where the metal strikes the bottom. Under the plate the mould should be thickly nailed, for it is very rarely that the metal falling does not cut away the plate on the bottom, and if the under surface is well nailed, it will have still greater resisting power against the cut of the falling metal. The boiler plate placed on the bottom of mould ought never be nailed in position, for it is sure to curl with the action of the heat, and if nails are used to hold it in position the chances are that in curling up it would tear out its fastenings, loosening parts of the mould's surfaces and endangering the loss of casting.

Plungers, cylinders, and work of that nature, when requiring a sound finish, ought always be poured with the first metal from the furnace, and that metal ought always to be very hot, for gases and air bubbles will pass more readily through liquid metal than through a dull, sluggish mixture; besides, the ladles on the early part of the heat are clean, and the furnace is clean, and if a special mixture is desired, this is the time it can be put in the cupola to best advantage. For such class of work a preponderance of close-grained iron should always be used; the aim should be rather to make the casting close, than open grained, and soft iron should be used sparingly; for a sound casting, close-grained iron is always preferable.

Sometimes, despite all precautions, the casting will be found at the top to have shrink holes, and sometimes this can be avoided by driving 20 penny nails into the mould at the top or flange, letting the heads stick out 2 or 3 in. into the mould. These tend to chill the casting at its warmest point, that the casting may all

solidify at same time. Another, and I believe one of the best ways, is to throw water on the pouring gates and basin the instant the piece is poured. All observing foundrymen have noticed that immediately after a casting is poured in loam or dry sand, the hot metal wells up through the pouring gates into the basin, as though the metal swelled inside the mould and meeting resistance from the mould's surfaces eases itself by pushing out through the pouring gates. This can be tested by raising the pouring head and flowing a mould through on to the ground, and then stopping for a moment; it will be found that the metal, of its own accord, will start flowing again quite perceptibly if the casting is a heavy one.

This does not occur on a green sand mould, for the latter mould will strain to accommodate the swell of metal, and the gate on the top will show no very perceptible sign of what is going on inside. Chilling the gates and pouring basin with water has a tendency to hold all metal that enters the mould.

When the metal is through swelling, if it has not life enough within itself to feed back, its density is impaired at the top of the casting, and shrink holes and gas holes are the result.

Some very good loam moulders claim that almost any loam mould that comes into ordinary practice will show a casting free from shrink holes or shrink depressions if the mould is put together rigidly enough to withstand all strains brought against it through the action of the molten metal. It certainly is astonishing, the castings in loam, weighing tons and tons, that are successfully cast without "churning rod," "flow-off," or "feeding riser."

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THE whole of the works of Charles Wilcox, Limited, of Tipton, have been offered for sale. The various lots included the Etna Sheet Mills, the Tividale Sheet Mills, the Hecla Galvanising Works, the Empire Tube Works, and the Gospel Oak Works, with the mines and minerals underlying. No bids were forthcoming and all the lots were withdrawn.

MESSRS. J. ABBOT & COMPANY, Gateshead, are supplying a new iron building for the Seaham Harbour Foundry Company, to replace the premises in which foundry work was formerly carried on, but which have recently undergone demolition. As soon as the new building is completed, this foundry business will be resumed by the Seaham Harbour Company.

COLD- *V.* HOT-POURED METAL.*

THERE are two things which determine whether metal will roll or not: First, ductility or softness. Second, the crystalline condition. This condition may be exemplified in the case of spelter which, when cold, is in a coarsely crystalline condition, and will not roll at all. When heated to a temperature a little below its melting point, the structure is changed so that the grain becomes close and fine, and the metal will roll. In this case there undoubtedly is an increase in ductility when heated; but as sheet zinc, when cold, has sufficient ductility to roll, it will readily be seen that it is the crystalline structure of the plate spelter which prevents it from rolling.

This same condition exists in all metals which may be rolled into sheet, and by careful manipulation either a fine or coarse grain may be obtained in the metal. In brass casting for rolling mill work, cast plates are often encountered which will not roll, and chemical analysis fails to reveal the true condition. The mixture is not at fault. Neither are the metals of which the brass is composed. Investigation generally fails to reveal the true cause, as such a state of the metal is undoubtedly caused by the heat of pouring. That a crystalline condition in metals is dependent upon the pouring heat has long been known, but it is not always borne in mind when looking for the cause of metal cracking in rolling.

If the reader will perform a little experiment, the result which he will obtain will be very instructive. Dissolve some ordinary alum in water so that a clear solution is obtained and divide into two parts. Let one part be boiled down so that a thin pellicle forms on the surface and then allowed to cool. The other is allowed to slowly evaporate in the air. If the experiment has been carried out successfully, the following results will be obtained: Crystals of alum will be obtained from both. The one which has been boiled down so that the solution is concentrated will give fine crystals, while the solution which has been slowly cooled or allowed to crystallise in the air will have large and coarse crystals in it. It will be found that the slower a liquid passes from the liquid to the solid condition, the larger the crystals, while a rapid cooling gives fine crystals.

While the preceding case is one of anqueous solutions, the same rule applies to metals and alloys, and, indeed, almost

* From the "Brass World."

identical results may be obtained with an alloy containing 80 per cent. of lead and 20 per cent. of antimony. Let this alloy be cast at a bright red heat, and also at the lowest possible temperature at which it will run; fracture the brass which is cast and notice the results. It will be found that the hot poured metal will be coarsely crystalline, while the other will have a finer grain.

It is believed that this law, so to speak, will apply equally to all metals and alloys,

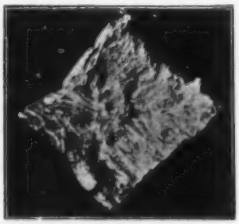

FIG. 1.—BRONZE POURED AT HIGH TEMPERATURE.

and a case in point is herewith cited which will serve to illustrate it: Aluminum bronze will roll either hot or cold, and for the reason that it is difficult to obtain good castings when cast in moulds which give a thin section, it has been customary to cast it in an open "cake" mould so that the result is the usual form of copper cake used for hot-rolling. The size ordinarily used is that which gives a "cake" 4 by 12 by 12 in. Such a "cake" is, of course, rolled hot.

In a mould of this kind was poured aluminum bronze. The alloy was a 4 per cent. aluminum bronze, consisting of 96 per cent. of Lake copper and 4 per cent. of pure aluminum. Nothing else was used. A No. 200 crucible was used in order to have sufficient for two moulds. The metal was allowed to become nearly white hot, rather an orange heat, perhaps. The crucible was removed and skinned, and the first mould was poured. The metal was now cooled with gates and scrap so that it was as cool as it could possibly be, and yet run. From this metal the second mould was filled. Bars one inch square were cut off from each plate on a planer, and put into a testing machine and pulled apart. The hot-poured bar showed a coarse, crystalline fracture when broken. This fracture, magnified twice, is shown in Fig. 1. The cold-poured bar has a fine-grained, fibrous structure, and was free from any crystalline appearance. This fracture, magnified twice, is shown in Fig. 2. By comparing the two fractures, the difference will readily be seen. The bars, before testing, were exactly one inch square, and when the photograph was taken the magnification was the same.

After the test bars had been cut from the "cakes" each was rolled. The hot rolling process was used, and care taken to be sure that both were at the same heat. The "cake" which had been poured at a high "heat" cracked badly in rolling, while the cold-poured metal rolled perfectly. The hot metal had cooled slowly, and, therefore, had had the time to form large crystals, as shown in Fig. 1. The cool metal cooled so quickly that the grain was fine and free from crystalline structure.

In connection with these interesting results there is one consideration which must be brought out: That is, the danger of having metal too cold. In brass casting, for example, a metal which is too cold will not free itself from the oxide which is carried in with the metal. Neither will the oil reduce the oxide from the surface of the stream where it enters the mould. In order to obtain these two important conditions, it is necessary that the "heat" of the brass shall be right. Cold-poured metal gives dirty or spilly castings. On the other hand, metal which has been allowed to overheat in the fire and poured at a high temperature will not roll well, but cracks will form in breaking down. Moulds which have become overheated from too many "rounds" having been cast in them will also produce the same results. The heat of the mould does not allow the

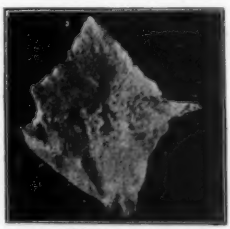

FIG. 2.—BRONZE POURED AT LOW TEMPERATURE.

metal to cool as it should, and the crystalline condition is produced. The proper temperature is that which will produce clean castings and allow the metal to solidify as quickly as possible. While hot metal produces the cleanest castings, that which is overheated will solidify with the crystalline condition.

The caster should be cautioned against misinterpreting this article, and think that he is getting his metal too hot. In

fact, the danger in the casting shop is apt to be the other way, on account of the need of keeping the spelter loss as low as possible. In metals which are cast in "cake" moulds of large section, in sand castings in which a high tensile strength must be obtained, and in alloys which do not contain spelter, care should be taken to avoid overheating. In the brass alloys, however, the spelter which burns at the top of the crucible is such a good indication of the temperature that the caster rarely errs in having his "heat" too high. When metal cracks in rolling, however, the problem of temperature of the metal should be investigated. In many instances it probably will be found that it is the cause, and no chemical analysis will show it. Brass or other alloys which have been made from the very purest materials may crack in rolling if the heat is too high when they are poured or the mould has been used too long without cooling. Slow cooling, whether caused by overheating or too hot a mould, will give the crystalline condition and with the accompanying tendency to crack in rolling. If one desires to see this condition manifested in a marked degree, let him cast some brass in a large section in sand and find whether it will roll or not.

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THE LANCASHIRE AND YORKSHIRE RAILWAY COMPANY have decided to adopt in future the 95-lb. rail on their main line.

SOMETHING ABOUT BRASS FOUNDRY FURNACES.

THE furnaces in many brass foundries are crude affairs and can be called without much exaggeration a bricked-up hole, a few old pieces of iron for grate bars and a cover. The question of convenience is too often overlooked and the work is made much harder than it should be.

The question of economy, either of fuel or labour in attending to the fire, is rarely considered, and except in a few foundries which have adopted modern tilting furnaces of the Bray or Steele-Harvey type, furnaces are much the same as they were 20 years ago. Fig. 1 shows a foundry furnace of the usual type. There are six furnaces in this group or bank, each about 24 inches square (outside measurement), and consisting of cast iron bodies or plates bolted together. The furnace is square both inside and out, the lining being of ordinary fire brick about 4 inches thick. This leaves an opening of 16 inches for the pot or crucible, which allows about 2 inches on a side around a 175-pound pot.

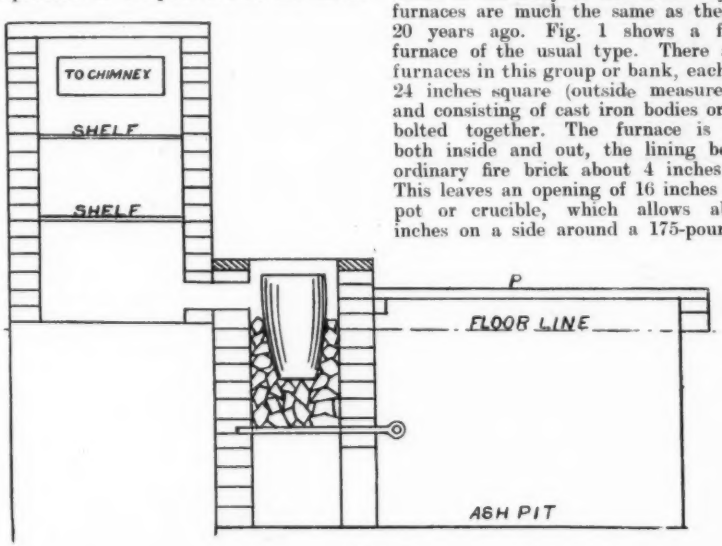

FIG. 1.

The core oven is adjoining it and is heated by the escaping gases from the furnaces. While the sketches are not drawn to scale, they represent the proportions fairly well. The floor plates are perforated to allow any metal or dirt to drop through into ash pit, and in this case the outer ends are supported by pedestals made of about six inches of 2-inch pipe with a flange screwed on each end; these are not shown in sketch. The ash pit is about 3 feet below floor level and probably 4 feet wide, giving room for a boy to work—cleaning the flues and getting out ashes. The grates consist of ¾-in. iron bars, pushed through holes in the brickwork, with a hook or eye on the outer end to help in pulling it out. The consumption of coal varies with different conditions of draught, etc., and it seems strange that so few foundries make

any provision for forced draught. Not that it is necessarily more economical at all times, but there are times when the natural draught is below its normal

shown was given as 2,000 pounds for five days, to each three furnaces, or 400 pounds melted with 133 pounds of coal.

A much better arrangement is that shown

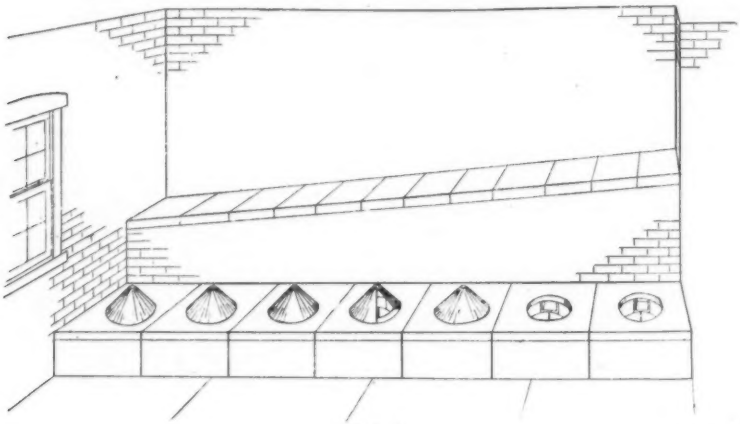

FIG. 2.

intensity and time as well as fuel could probably be saved by the use of a blower. There is probably a certain rate of combustion at which each furnace will give best

in Fig. 2, the men being across the end of the foundry away from the moulders, who thus keep comparatively cool. The furnaces connect with the flue behind,

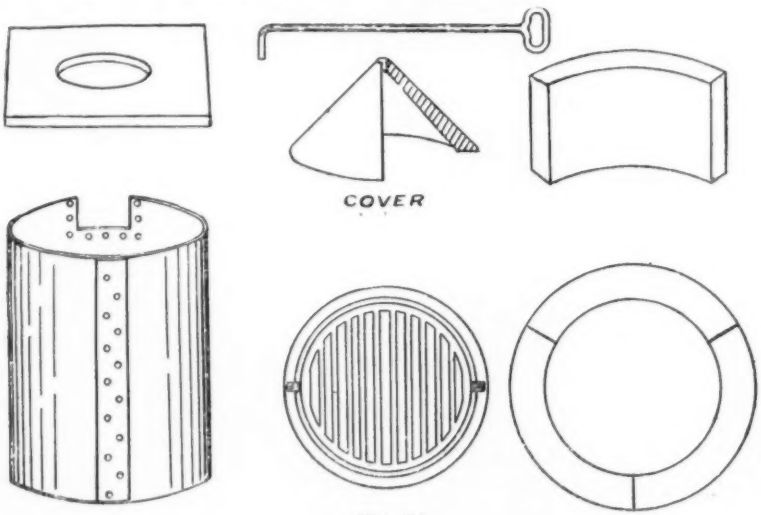

FIG. 3.

results, and if a small blower was handy that combustion could be maintained at the economical rate.

The fuel consumption in the furnace

which gradually increases in capacity towards the chimney. The flue is inclosed at the top with large brick slabs, which can readily be removed to provide

for the cleaning of the flue. The furnaces themselves are shown in Fig. 3, and consist of steel shells 26 in. in diameter by 30 in. long. They are rivetted with a butt seam, as shown, and a notch or opening is left to which is bolted a cast iron funnel which leads to the flue. The furnace is lined with fire brick, three bricks making a circle, and as they are three deep there are nine bricks to a furnace. The bricks are stock, and are not specials. There is a cast iron base ring which rests on the foundation, and on which the tilting grate and its ring are placed, the furnace shell resting on the outer grate ring. The grate is cast with trunnions for tipping, and has a catch in front (not shown). This probably costs no more than the arrangement shown in Fig. 1, and is much more convenient.

The top or cover plate is also shown in the figure, being simply held to the bottom plate by four bolts, then the front bricked in to prevent radiation of heat, both for economy and comfort of man or boy cleaning out the ash pit.

The cover plates in the first case were rectangular with wrought iron handles cast in them, to be removed by hooks before lifting the pot. Figure 3 shows the round cover used in the latter furnaces and having a round hole in the top, allow the insertion of a hook as shown.

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The Patiñer Iron and Steel Company, Limited, Wishaw, N.B., have determined the arrangement by which Messrs. W. F. Dennis & Company represented them in London. The firm have now opened an office at 25-26, Lime Street, E.C.

The progress of the Parsons' turbine since its introduction has been very rapid. Since 1889 Messrs. C. A. Parsons & Company have supplied machines to 25 Corporations, to the District Councils of Watford and Shipley, to the British Government, to the Colonies, and to many electric lighting companies, factories, collieries, etc. Last year the company turned out at the Heaton Works 70,000 horse-power.

In view of the great interest which is being taken in the desiccation of air for the blast for blast furnaces, which is accomplished by the aid of mechanical refrigeration, it may be of interest to our readers to learn that one or two of the leading makers of refrigerating plant in this country are now prepared to contract for plants. J. & E. Hall, Limited, of Dartford, Kent, whose works comprise all the departments necessary for the manufacture of their refrigerating machines, have drawn up complete designs.

BRONZES AND ART-CASTINGS.

In order to define clearly the scope and purpose of this article, it is desirable that a classification should first be given. The following may be taken as fairly comprehensive:—

1. Artistic bronzes and ornamental bronzes, including statues, statuettes, vases, decorative candelabra, etc.
2. Iron castings, comprising figures, vases, tazza, fountains, candelabra, railings, balconies, crosses, and miscellaneous articles.
3. Imitation bronze (composition), including composition for clock-cases, tazza, vases, candlesticks, etc.
4. Galvanised cast iron.
5. Zinc figures and ornaments, statues, statuettes, clocks, vases, etc.

It will be seen that this includes a tolerably wide range of industry, although all bearing with that of casting in metal. The peculiarities and artistic effects are one in principle, however much they may vary in detail.

The metallic alloy, called bronze, varies slightly in its composition in various countries.

The conditions necessary for the development of this branch of industrial art appear to be a knowledge of the principles of artistic design and a love of art fairly spread through the people generally. The exceptional products of some countries, however excellent in themselves, are no evidence that the public sentiment existing in these countries at all approaches what we see at this day in France, and especially in Paris.

Partaking so largely of the highest artistic elements of design, the bronze manufacture may be considered a trade only by the extent to which it is, or can be, carried in the constant reproduction of the same subjects. Beyond its power of extension and the readiness with which the designs and models, together with the proper appliances for repetition, can be obtained in a properly trained community, the manufacture of bronzes and high-class metal castings is in reality a fine art, and depends for its success upon its close approximation to, and continuous connection with, the art of sculpture in its best and most enduring forms. The marvellous reproductions of antique bronzes of the Italians would go far to prove this, even if it were not patent to everyone that the education and training of the bronzist who is to be at all successful in his business, must be essentially that of the artist; for however skilfully the model may be executed, or however perfect the casting produced from it, the

fact that the finish must be that of the artist is self-evident.

This article must, then, whilst treating of manufacturing technicalities, branch off also into considerations of art, and of those principles which govern the production of art-objects in the various materials and by the numerous methods which it will be necessary to examine and treat upon. This will,however, be done more in an explanatory than in a critical sense.

The extent to which objects of art in bronze are produced in France is fairly illustrated by the varied productions of Paris; as that city is the centre of this class of metal-work.

Some years ago, the bronze industry of France employed about 11,000 workmen, whose wages varied from 3s. 6d. to 6s. 6d. per day, the more skilful and artistic obtaining much higher payment. The value of the annual production of bronzes in France was estimated at 70,000,000 fcs., or £2,800,000 sterling. Formerly the exports were much larger than they have been of late years. This falling off may be attributed to competition with England, Belgium, Germany, and Russia, in which countries efforts have been made to establish the production of bronzes for home demands, if not for export, thus bringing these countries into a double competition with France. In England there can scarcely be said to be any decided production of commercial bronzes. Our efforts have been chiefly confined to the production of works of a large and important character for public monuments, and, with the exception of a few firms, the smaller works are not produced at all, and by these firms in very small quantities for home demand only.

The rise and progress of the bronze manufacture in France are attributable to the almost universal spread of love of art and decoration. As regards the workers, so early were the leading men in the bronze trade alive to the proper education of all connected with this industry, that some sixty years ago they established a school of art or design, specially for the bronzists of Paris, which received pecuniary assistance from the municipality of Paris and also from the Government. In this school nothing was taught that did not bear directly upon the pursuit of the student, who must be employed, or intended to be employed, in a bronze foundry. This school was subsequently abandoned.

French bronzes may be broadly divided into two classes:—

1. Those which are designed and modelled as works of sculpture, and owe their interest and value to the higher qualities of fine art, in which statuesque severity of form, expression, and dignity of treatment are combined to produce a given result in the material selected, without factitious aids from variation of colour, gilding or silvering, or combination with other materials.

2. Those which are essentially decorative in character, and which, whilst possessing many of the qualities of those named above, are yet so finished in detail and so varied in their effects of colour, gilding, silvering, and enamelling as to make them ornamental and picturesque, rather than statuesque and severe.

Upon the capacity to produce works in the first class the power to achieve success in the second class must entirely depend. The art education of the bronzist in France is that of the sculptor, and the power thus cultivated is directed to the special manufacture or continuous repetition of designs. The growing demand of the last 20 years has undoubtedly encouraged the development of this kind of art-skill until it has produced an important industry of great national importance, not only in this special direction, but also in the production of works in iron and zinc.

The skill manifested by the bronze casters of Paris was also directed to the manipulation of ornamental and decorative iron castings; although fifty years ago very little had been done in this direction, and the iron trade of France can scarcely be said to have had even an incipient existence.

We now see the result of this in ornamental iron castings, in which the skill of the bronzist and the artist has been successfully combined with the best science of the ironfounder and trained metallurgist. Nor has the skill thus developed and carefully cultivated failed to re-act upon the practice of the bronzist. The efforts of the latter to overcome what, at first sight, appear insurmountable difficulties in casting art works in iron in one piece, from the fact that the system of "firing on" portions which in bronze can be cast separately cannot be readily applied to iron, has led to the adoption of a similar course of action in the casting of bronze figures and groups in one piece, thus eventually simplifying and cheapening the process. It is, therefore, perfectly in accordance with common sense and experience to assume that many important works in bronze of a complicated character owe much of their success to the manipulative skill and experience gained by the moulder in the successful efforts to produce fine works in the inferior, or at least cheaper, metal, iron, from the fact that if produced at all they must be cast in one piece.

CONNECTING FLASKS.

Mr. James Cunningham, an American foundryman, of Florence, Mass., has a patented pin connection for aligning the cope and drag of a moulding flask and clamping them together. The pin can be inserted from above or below the bracket lugs and may be withdrawn and used for other flasks, etc.

Fig. 1 is a front view of the connection applied to a flask. Fig. 2 is a side view, and Fig. 3 is a plan of the lower bracket shown in the preceding views. Fig. 4 is a front view of a pin provided with locking lugs in addition to the clamping lugs, the associated bracket ears being indicated by dotted lines.

The first three views show the pin applied to the two sections of a flask. A bracket comprising a plate and ear A is fastened by screws to the cope and a similar bracket is attached to the drag,

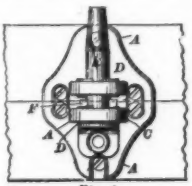


Fig. 1

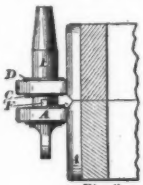


Fig. 2

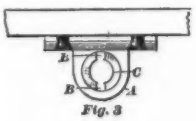


Fig. 3

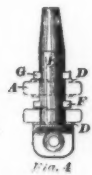


Fig. 4

both brackets being in the same vertical plane. The ears project forward from the plates and have slots B. On the side of the ears near the supporting plates are cam surfaces C, one of them starting from the side of the forward slot B and ending at the corresponding side of the rear slot B, increasing in thickness from front to back. A similar cam surface is around the other side of the opening through the ear. Flanges are formed on the ears as at D as bearing surfaces for the head of a pin E. These flanges bound opposite sides of the holes and slots in a similar manner to the cam surfaces C.

The pin E has the head at one end and oppositely disposed lugs F intermediate of the head and the other end of the pin. The pin E fits the hole in the lug and the projections F slide through the slots and when the pin is turned ride on the cam surfaces C. The rotation of the pin locks the ear between the lugs and the head.

In addition to providing means for aligning the halves of a flask it may be necessary to fasten the sections together so that the cope cannot be lifted from the drag. In Fig. 4 two additional lugs G extend from the pin E between the lugs F. These lugs are arranged to engage the flanges D on the ear through which the pin last passes, when the latter is turned to bring the projections F into engagement with the cam surfaces.

—o—

CHILLED CASTINGS.

This is a subject which has not yet been scientifically investigated to any extent, consequently there is very little comparative data on record. So far, the depth of chill of iron for this purpose has been judged by the appearance of the fracture, and very accurate are the opinions of practical men in the Staffordshire chill roll trade. In some cases now chilled samples are cast in the pig beds alongside of the pigs, and this gives the accurate depth of chill in the pig before re-melting. The writer is engaged on a research on this matter, so it is somewhat premature to attempt to give any definite data, but it may be broadly stated that, generally speaking, pig containing silicon 1.50 and upwards, depending upon the condition of the carbon, has practically no chilling properties, and the lower the silicon from that point the deeper will be the chill, until purely white iron is obtained. This is, of course, given sulphur, phosphorus, manganese, etc., as constant, but each of these again has its influence on the depth of chill.

The following table gives typical analyses of different classes of castings made in this country

TABLE I.

Class of Casting.	G.C.	C.C.	Si.	S.	P.	Mn.
Chilled and Grain Rolls ..	2·60	·75	1·00	·09	·50	·50
General Chilled Work ..	2·80	·75	1·00	·09	·50	·75
Cylinder and Hydraulic Work	3·00	·65	1·30	·08	·50	1·00
General Machinery	3·20	·45	1·80	·06	1·30	1·00
Ingot Moulds	3·25	·45	2·10	·05	·65	1·00
Stove Grate, Hardware, and small work ..	3·60	·15	2·50	·04	1·50	1·00
General Castings	3·20	·45	2·00	·07	1·50	1·00

—o—

The business of Siebe, Gorman, & Company, Limited, Neptune Works, Westminster Bridge Road, S.E., has been acquired by Vickers, Sons & Maxim, Limited.

TRADE TALK.

It has been decided to voluntarily wind up the Perfecta Seamless Steel Tube Company.

The Redbourn Hill Iron & Coal Company, Limited, have removed their office to Frodingham.

The works of the York Engineering Company, Limited, are being offered for sale by private treaty.

Messrs. Tyler & Duncan, electrical engineers, of New Bridge Street, London, E.C., have dissolved partnership.

Mr. M. S. Stevenson, trading as Stevenson's Metal Company, of Birmingham, has been adjudged bankrupt.

An outbreak of fire occurred during the month at Allanton Foundry, Newmains, doing damage to the extent of £2,500.

Rowledge Iron Works Company, Limited, has been formed with a capital of £6,000 in £1 shares (5,700 preference).

A vessel has arrived at Cardiff with a cargo of 1,600 tons of German coke to the order of Guest, Keen & Nettlefolds, Limited.

A receiver and manager has been appointed in connection with the affairs of the Darlington Wagon and Engineering Company.

Harrison, Ainslie & Company, Limited, have just removed their head office from Cavendish Street, Ulverston, to Lindall Moor.

Messrs. G. Gell and E. Hordley, who traded under the style of Hordley & Gell, as iron founders, at Hanley, have dissolved partnership.

The s.s. "Westwood" has been fixed to carry a machinery cargo for Guldsmedvik (the port for Dunderland), at 4s. per ton, early May loading.

The business of S. Thompson & Company, Limited, Manor Iron Works, Bilston, has been acquired by Baldwin, Limited, Stourport.

Messrs. Taylor, Pallister & Company, Staiths Engine Works, Dunston, have laid down plant for the manufacture of a patent steam winch.

The Hozier Engineering Company, Limited, have acquired land at Alexandria, Scotland, for the purpose of erecting new works.

Messrs. J. E. Sells and J. Allam, engineers, of Rotherhithe, S.E., who traded under the style of Sells & Allam, have dissolved partnership.

A meeting has been held of the creditors of R. Cundall & Sons, Limited, of Airedale Iron Works, Shipley. It was decided to appoint a committee of enquiry.

The shareholders of the David Kimberley & Sons' Tool Manufacturing Company, Limited, have resolved to wind the concern up in voluntary liquidation.

A receiving order has been made in connection with the affairs of Mr. D. Hatch, of the Bingfield Iron Works, Bingfield Street, King's Cross, London, N.

The Capell Fan Company, of Newcastle-on-Tyne, have appointed Mr. A. Leighton Stevens, 19, Western Mail Chambers, Cardiff, their sole agents in South Wales.

The Staveley Coal and Iron Company, Limited, are contemplating the erection of a modern bye-product plant consisting of two batteries of thirty-six ovens each.

It was recently reported that Cammell, Laird & Company, Limited, had bought the Lowther Iron Works, Workington, but the rumour lacks official confirmation.

A fire broke out recently in the fitters' shed at the shipyard of D. & W. Henderson & Company, Limited, Partick, Scotland, doing damage estimated at about £3,000.

The voluntary winding up of the firm of Bryan, Donkin & Clench, Limited, has been decided upon, and Mr. A. G. Webb, the secretary, has been appointed liquidator.

W. T. Henley's Telegraphic Works Company, Limited, are installing in their works a Wilson patent gas exhaust boiler for the hot gases coming from their gas engine.

At Palmer's shipbuilding establishment at Jarrow the framework of a large steel gantry is being constructed for the purpose of erecting it over the berth for battleships.

The Barrow Hematite Steel Company, Limited, have placed an order with Simon Carves, Limited, of Manchester, for an additional battery of bye-product coke-ovens.

An explosion occurred at Messrs. Strang & Sons' Prince's Foundry, Ramsbottom, recently, during the casting of a cylinder weighing about 15 cwt. The works were not damaged.

Oldbury Steel Conduits, Limited, is the style of a new company formed with a capital of £3,000 in £1 shares, and offices at Buckfield Lane, Oldbury, Worcestershire.

Messrs. C. W. Gunther, J. A. Gunther, and E. J. Gunther, mechanical engineers, Oldham, Lancashire, have dis-

solved partnership so far as regards Mr. C. W. Gunther.

THE WORKINGTON ENGINEERING AND WAGON COMPANY, LIMITED, has been registered with a capital of £8,500 in £1 shares, with offices at Marsh Side, Workington, Cumberland.

ARDILLA IRON COMPANY, LIMITED, has been registered with offices at Baltic Chambers, 108, Bishopsgate Street Within, E.C. The capital of the concern is £120,000 in £5 shares.

THE PARKER FOUNDRY COMPANY, of Derby, have appointed Mr. F. A. Porter, of 13, Queen's Square, Belfast, and 35, Parliament Street, Dublin, as their representative in Ireland.

HATHORN, DAVEY & COMPANY, LIMITED, of Leeds, have secured the contract to supply a 12 million gallon steam pumping engine to the Montreal Water Works for the sum of £6,687.

THE average selling price of No. 3 Cleveland pig-iron for the first three months of the year has been returned as 45s. 6.89d., as compared with 43s. 4.59d. for the previous quarter.

A DISSOLUTION of partnership is notified in connection with Messrs. J. Ferguson and R. N. Stephenson, ironfounders, etc., of Leicester, who traded under the style of Ferguson & Company.

MESSRS. DICK-CLELAND, HARPER & COMPANY, of 49, Jamaica Street, Glasgow, have been appointed sole agents in the Glasgow district for Messrs. Gemmell & Frow, engineers, of Hull.

THE shareholders of the Harvey United Steel Company, Limited, have agreed to the reduction of the capital of the company from £450,000 in £1 shares to £225,000 in shares of 10s. each.

THE GREAT WESTERN RAILWAY COMPANY have placed a repeat order with the Kennicott Water Softener Company for a water softener capable of dealing with 30,000 gallons of water per hour.

MR. E. SMEDLEY, partner in the Park Foundry Company, Limited, Belper, applied for his discharge at the Derby Bankruptcy Court recently, which was granted subject to suspension for three years.

THE CARDIFF CHANNEL DRY DOCKS AND ENGINEERING COMPANY, LIMITED, have acquired the graving dock at Newport and the repairing shop at Barry of the Severn Dry Docks Company, Limited.

MESSRS. HOWARD BROS., makers of the "Dey" time registers, have removed to larger premises at 40, Paradise Street, Liverpool. The firm's London offices are now at 100c, Queen Victoria Street, E.C.

REPRESENTATIVES of a German Syndicate of blast-furnace coke makers have lately met British users of coke in London for the purposes of discussing the question of the export to this country of German coke.

MESSRS. BROWN, LENOX & COMPANY, of Pontypridd, have started the manufacture of bearing and buffing springs for railway wagons and locomotives, also volute and spiral springs of all descriptions.

MESSRS. W. E. STEPHENS, J. F. STEPHENS, and R. E. BILL, trading under the style of J. Stephens, at Cwmbwrla, near Swansea, as smelters and metal manufacturers, notify a dissolution of partnership.

GRAHAM, MORTON & COMPANY, LIMITED, are supplying a large warehouse to the order of the Alexandra (Newport and South Wales) Docks and Railway Company. The building is to be 200 ft. long and of 70 ft. span.

PIERCY & COMPANY, LIMITED, is the name of a company formed to acquire the business carried on at Broad Street Engine Works and Lozells Street Foundry, Birmingham, by Piercy & Company. The capital is £15,000 in £1 shares.

THE new works at Luton of the Vauxhall Iron Works Company have been opened during the month. The company are the successors of Alex. Wilson & Company. The works are erected upon a site covering six and a-half acres of freehold land.

MANY users of machinery in London met recently to consider the question of the rating of machinery by the local authorities. A resolution was adopted to the effect that a committee should be appointed to consider the question and report to a subsequent meeting.

THE INCE FORGE COMPANY, LIMITED, of Wigan, were recently given an order for a double-throw marine crank shaft. The order was received at four o'clock on a Wednesday, and the shaft was forged, tooled, and finished complete, passed by Lloyd's surveyor, and on its way to its destination on the Saturday morning following.

THE CROWNPOINT BOILER WORKS, Glasgow, are being very extensively improved. A new bay, about 300 ft. long by 50 ft. wide, is being added, which is being fitted with high-speed electric travelling cranes. It has been decided to separate the marine and land boiler departments. Bladen & Company, Limited, of Glasgow, are supplying the structural ironwork.

PERSONAL.

Lord Kelvin has been the first recipient of the John Fritz Medal.

Sir Charles Mark Palmer is now making satisfactory progress towards recovery.

Mr. A. C. Newsum has been elected a director of the Lincoln Wagon and Engine Company, Limited.

Mr. A. M'Millan, secretary of Alley & MacLellan, Limited, has been appointed a director of the concern.

Mr. A. McGregor, of the Ardeer Foundry, Stevenston, Scotland, has been made a J.P. for Ayrshire.

Mr. A. Fellowes, manager of the Bede Metal and Chemical Company, Limited, has been appointed a director of the concern.

The late Mr. W. B. Shorrocks, the Bradford representative of the Low Moor Iron Company, left estate of the gross value of £3,751.

The gross value of the estate of the late Mr. Thomas Pittaway, of Rowley Regis, nail and rivet manufacturer, has been returned at £27,259.

Mr. Alfred Baldwin, M.P., has been elected chairman of the Great Western Railway Company. Mr. Baldwin is the chairman of Baldwins, Limited.

Sir Wm. Arrol, M.P., has been the recipient of a presentation from his friends in the House of Commons in recognition of his devotion to Parliamentary duties.

Mr. L. B. Schlesinger, of Messrs. A. Keyser & Company, 21, Cornhill, London, E.C., has been elected chairman of the National Electric Construction Company, Limited.

Mr. W. H. Bleckly, honorary treasurer of the Iron and Steel Institute, has been appointed a trustee of the Bessemer Medal Fund of that Institute, in succession to the late Sir Lowthian Bell.

Sir C. M'Laren, M.P., has been appointed a director of the Barry Railway Company. Sir Charles is also chairman of the Tredegar Iron and Coal Company and Palmer's Shipbuilding and Iron Company, deputy-chairman of John Brown & Company, Limited, and a director of the Sheepbridge Coal and Iron Company.

Mr. W. L. Johnson has been elected a director of Bell Brothers, Limited. Colonel C. Lowthian Bell, who recently retired from the management of the company's Clarence Works, will shortly be the recipient of a presentation from the employés. Colonel Bell, it is reported, is shortly leaving Tees-side for the South of England.

COMPANY NEWS.

Beyer, Peacock & Company, Limited.—Deficit of £587, after paying preference dividend.

The Mersey Forge Company, Limited.—Distribution of 1s. per share on account of capital.

Willans & Robinson, Limited.—Loss on half-year's operations, £42,771; debit balance, £79,952.

Bede Metal and Chemical Company, Limited.—Dividend, 5 per cent. per annum; carried forward, £2,788 0s. 1d.

Bruce, Peebles & Company, Limited.—Net profit, £28,792; ordinary dividend, 6 per cent. per annum; £3,854 carried forward.

Clayton & Shuttleworth, Limited.—Net profit, £94,068; reserve fund, £5,000; ordinary dividend, 6 per cent. per annum; £5,607 carried forward.

Babcock & Wilcox, Limited.—Net profit, £289,748; ordinary half-yearly dividend, 8 per cent. and bonus of 4 per cent.; reserve fund, £175,000.

Thames Iron Works Shipbuilding and Engineering Company, Limited.—Annual profit, £52,633; reserve account, £5,000; ordinary dividend, 5 per cent.

Browett Lindley & Company, Limited—Net result of the year's operations is a loss of £14,850, to which must be added £3,998 brought forward, making a total of £18,848.

North-Eastern Steel Company, Limited.—Annual profit, £22,350 16s. 11d.; debenture interest, £21,473; directors' fees, £1,000; expenditure, £3,658 4s. 4d.; carried forward, £347 9s. 9d.

QUERIES.

This department of the Journal *undertakes the answering of queries in foundry practice and pattern making. We trust our readers will afford us assistance in answering these queries so far as possible.*

Furnace.—Will any of your readers give me their opinion which they consider best, and takes least power—a fan or blower—for a small cupola 50 cwt. melting capacity per hour?

A Constant Reader.—Will any reader say if it is possible to make as good teeth-wheel patterns by machine tools as can be made by hand? A answer will much oblige.

ELDERS FOUNDRY COKE

As supplied to the British . . Admiralty Dockyards.

The following, selected from numerous letters, are eminent testimony as to the quality of our celebrated "A.A.A." Coppee Foundry Coke, carefully selected, and despatched in sheeted wagons.

From PECKETT & SONS, Bristol.

Bristol, October 25th, 1904.

We have been using your Selected Foundry Coke for some considerable time.

We have pleasure in stating that we are very pleased with it, as we find we get sounder and cleaner castings, more free from blow-holes and other defects, than we formerly did.

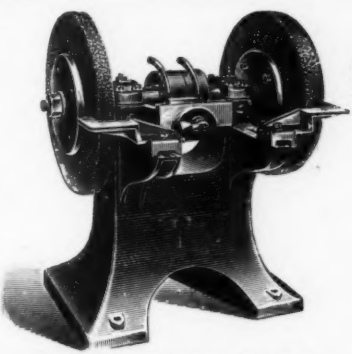
From MOUNTFORT PHILLIPS & Co., Llantrissant.

Llantrissant, October 25th, 1904.

In reference to the Foundry Coke you have been supplying us with for the last six months, we have very great pleasure in letting you know that it has given every satisfaction, and that our Works Manager and Workmen give it the highest praise.

Elders Navigation Collieries, LTD. Cardiff.

Nearly Fifty Years' EXPERIENCE in the Manufacture of Grinding Machines.



"CD" TYPE, MEDIUM GRINDER.

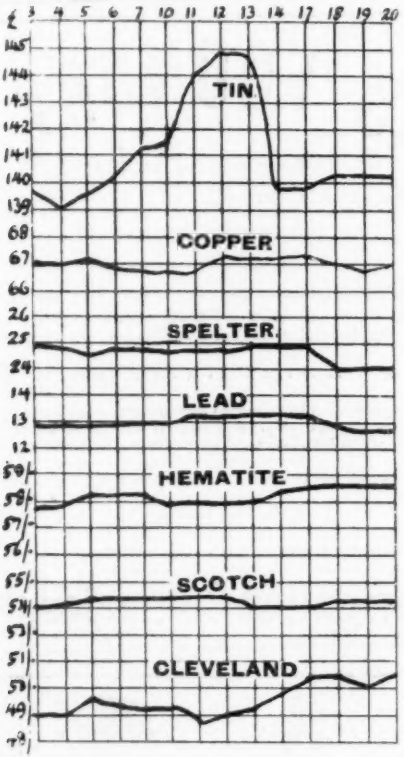
Machines complete with EMERY or CORUNDUM WHEELS, from £2 to £60.

Mitchell's Emery Wheel Co.

MILL STREET, BRADFORD, MANCHESTER.

Also at LONDON, GLASGOW, and BELFAST.

CHART SHOWING THE FLUCTUATIONS OF THE METAL MARKET IN APR., 1905.



PRICES OF METALS.

The following table shows the approximate latest prices and position of stocks of metals during the past two years :—

Metals.	1904-5.	1903-4.
Iron—Scotch pig warrant ... ton	54.1½	51/6
—Middlesbro' warrants ... ... ton	51/4	44.6
—W.C. M/nos Bessemer ... ... ton	58.6	56/0
—Stock, Scotch, April 27 ...tons	18,000	9,700
Copper—Chili bars, GMB ... ... ton	£68 17,6	£58 12,6
—Stock, Europe & afloat... ... tons	18,055	12,026
Tin—English ingots ton	£139	£129 10 0
—Straits ... ton	£139 5 0	£127 10 0
—Stock, Ldn. Hlnd and aflt ... tons	12 824	14,789
Lead—English pig ton	£12 12,6	£12
Spelter—Ord, Silesian ... ... ton	£24	£22
Quicksilver—(75lb.) bottle	£7 7,6	£8 2 6
Antimony—Regulus ... ... ton	£35 10 0	£29

Castings.

In the Cleveland district the following are the nominal rates current for castings :—

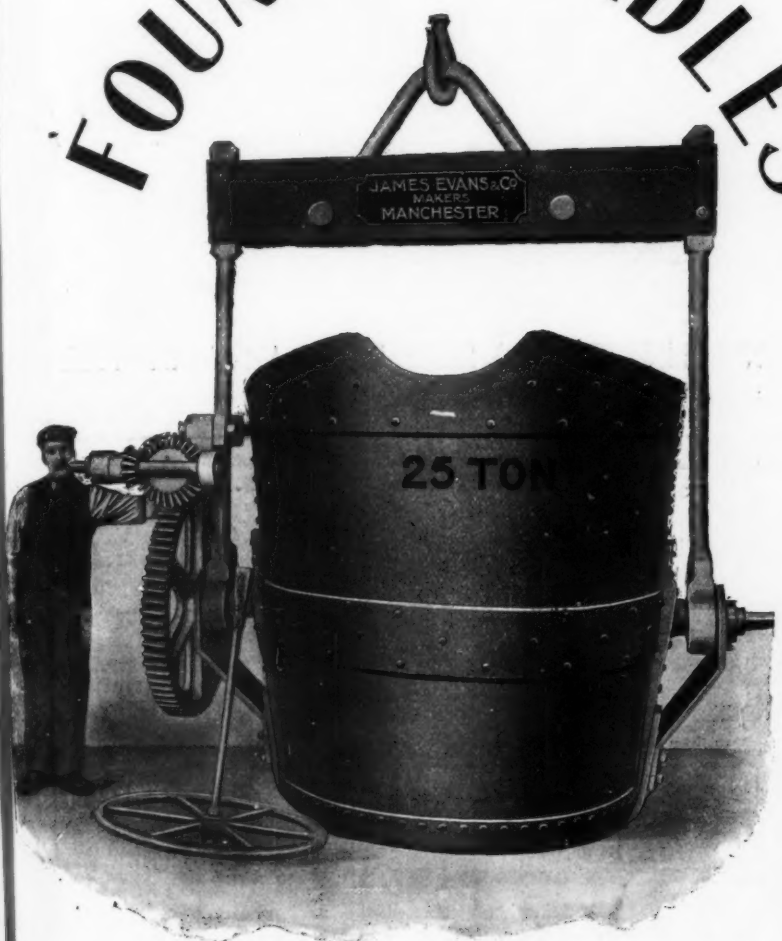
	£ s. d.		£ s. d.
Columns (plain)	6 10 0	to	7 0 0
Pipes, 1½ to 2½ in. ...	5 ½ 0	to	5 5 0
,, 3 to 4 in.... ...	4 12 6	to	4 17 6
,, 5 to 8 in. ...	4 10 0	to	4 12 6
,, 10 to 16 in.... ...	4 10 0	to	4 12 6
,, 18 to 24 in.... ...	4 10 0	to	4 12 6
Chairs	3 10 0	to	3 12 6
Floor plates (open sand)	3 0 0	to	3 2 6

Scrap.

The quotation for scrap subject to market fluctuations is as follows :—Engineers' heavy scrap, 50s. to 52s. 6d.; ditto light scrap, 20s. to 22s. 6d.; clean scrap brass, 37s. 6d.; clean scrap copper, 57s.; lead (usual draft), 11s. 3d.; tea lead, 10s. 3d.; zinc, 17s. 9d.; hollow pewter, 100s.; black pewter, 65s. per cwt.

Contractors to H.M. Government.

FOUNDRY LADLES

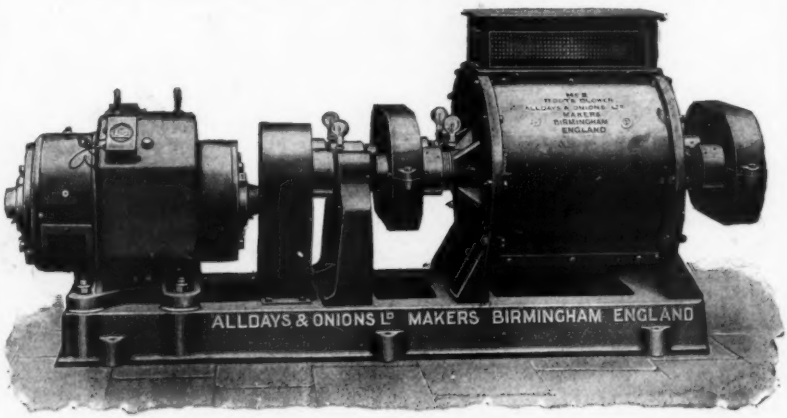


JAMES EVANS & Co., FOUNDRY ENGINEERS,

Telegrams:
"LADLES, MANCHESTER."

BRITANNIA WORKS, MANCHESTER.

ROOTS BLOWERS.



ALLDAYS & ONIONS PNEUMATIC ENGINEERING CO., LTD., BIRMINGHAM.

AND AT 20 BUCKLERSBURY, LONDON, E.C. Telegrams: "ALLDAYS, BIRMINGHAM."

38¼"
McNEIL'S
PATENT UNBREAKABLE
STEEL LADLES
These Ladles are manufactured by a patented process, each from a single steel plate without weld or rivet. They are extremely light, being at the same time the strongest and most durable in the market. Ladles to contain 56 lb. of metal only weigh about 7 lb. each. They are made of all capacities from 30 lb. to 60 cwt., with or without lips; also mounted or unmounted. They are also suitable for chemical and metallurgical processes. List of sections and prices on application to
CHAS. McNEIL.
KINNING PARK IRONWORKS,
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36"
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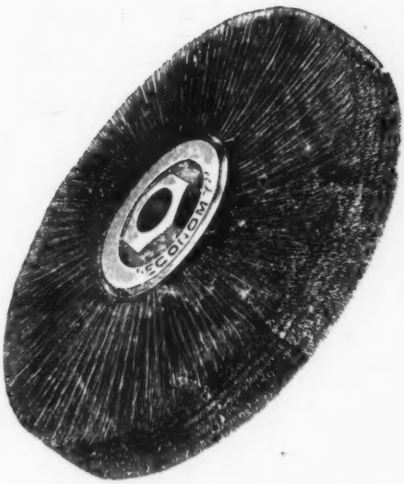

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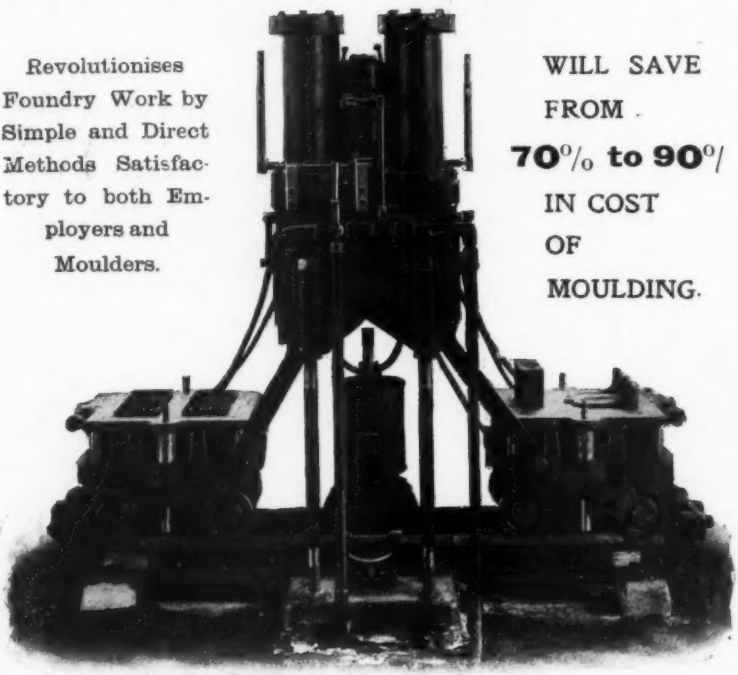

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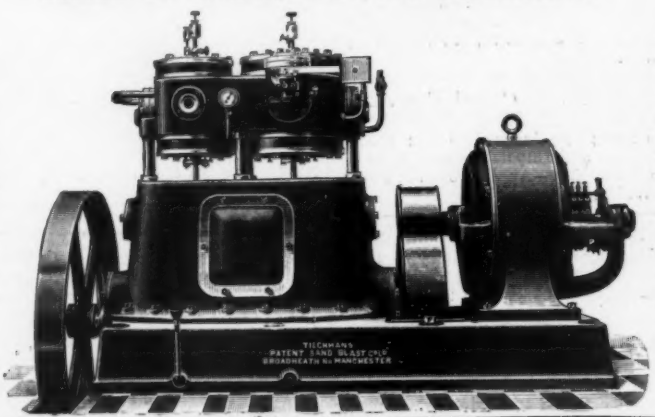

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